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AMERICAN

# DYESTUFF REPORTER

Devoted to Textile Chemistry
BLEACHING • DYEING • PRINTING • FINISHING

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# Bright... and right for the great outdoors

## National Carbanthrene Brilliant Orange RK Paste

This National Dye is the brightest, fastest, and reddest vat orange in our line. It is highly recommended where very good fastness to prolonged outdoor exposure is desired, such as for upholstery, sportswear, work clothes or industrial uniforms, draperies and other fabrics.

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*Proceedings of the*

# American Association of Textile Chemists and Colorists

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*Editor of Proceedings:* Carl Z Draves, 30 Lahey St, New Hyde Park, N Y

OCTOBER 11, 1954

## AATCC CALENDAR

**COUNCIL**
1954—Nov 19 (Hotel Roosevelt, New York).
1955—Jan 21 (Hotel Statler, New York), Apr 15, June 17.

**NATIONAL CONVENTIONS**
Sept 21-23, 1955 (Chalfonte-Haddon Hall, Atlantic City, N J; 1956 (Waldorf-Astoria, New York); 1957 (Boston).

**HUDSON-MOHAWK SECTION**
Oct 29 (Johnstown, N Y); Dec 2, Jan 14, Feb 25, April 15 (Albany, N Y); May 20 (Ladies Night); June 24 (Annual Outing).

**MID-WEST SECTION**
Oct 30 (Bismarck Hotel, Chicago, Ill).

**NEW YORK SECTION**
October 15, November 19 (Kohler's Swiss Chalet, Rochelle Park, N J); January 28 (Georgian Room, Hotel Statler, New York); February 25 (Skytop, Hotel Statler, New York); March 18, April 22, May 20 (Kohler's Swiss Chalet, Rochelle Park, N J).

**NORTHERN NEW ENGLAND SECTION**
Dec 10 (Woodland Golf Club, Auburndale, Mass).

**PACIFIC SOUTHWEST SECTION**
Oct 30 (Outing—Ojai, Calif); Dec 3 (Gourmet Restaurant, Beverly Hills, Calif).

**PHILADELPHIA SECTION**
Oct 29 (Penn-Sherwood Hotel, Philadelphia, Pa); Dec 3 (Kugler's Restaurant, Philadelphia).

**PIEDMONT SECTION**
Oct 16 (Hotel Barringer, Charlotte, N C).

**RHODE ISLAND SECTION**
Oct 14 (Johnson's Dummocks Grille, Providence, R I); Dec 2 (Annual Meeting —Sheraton Biltmore, Providence, R I).

**SOUTH CENTRAL SECTION**
Dec 4 (Hotel Patten, Chattanooga).

**SOUTHEASTERN SECTION**
Dec 11 (Atlanta-Biltmore, Atlanta, Ga).

**WASHINGTON SECTION**
Dec 8 (Pepco Auditorium, Washington); Feb 11 (Washington); May 20.

**WESTERN NEW ENGLAND SECTION**
Nov 12, Dec 10 (Rapp's Restaurant, Shelton, Conn).

**WESTERN NEW YORK SECTION**
Nov 27 (Hamilton, Ont); Jan 14 (Buffalo); Mar 4 (Hamilton, Ont); April 22 (Buffalo); June 24 (Outing).

## EMPLOYMENT REGISTER

*This column is open for two insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association, Lowell Technological Institute, Lowell, Mass. It is understood that these will be open to inspection by prospective employers who can obtain further information from the Secretary.*

54-22

*Education:* PhD, physical chemistry.
*Experience:* Research supervisor and chief chemist.
*Age:* 38; married; eastern US preferred.
9-27, 10-11

54-23

*Education:* BS, chemistry.
*Experience:* Textile chemist and engineer.
*Age:* 37; married; references; position as technical service representative or textile chemist desired, eastern US.
9-27, 10-11

54-24

*Education:* BTC, textile chemistry & dyeing.
*Experience:* Dyestuff salesman & demonstrator, head of branch office now closed.
*Age:* 41; married; references; New England preferred but not essential.
9-27, 10-11

## ACTIVITIES OF THE LOCAL SECTIONS

### Pacific Southwest

FUTURE dates of the Pacific Southwest Section include the annual outing on October 30th at Ojai Valley Inn, Ojai, Calif, and a regular quarterly meeting on December 3rd at the Gourmet Restaurant, Beverly Hills, Calif. Guest speaker for the latter meeting will be Raymond W Jacoby, Ciba Co, Inc, on "Textile Processing in the United States and Europe."

—♦ ♦—

### Hudson-Mohawk

THE Hudson-Mohawk Section held its first meeting of the fall season at Jack's Restaurant, Albany, N Y, on September 24th, with fifty members and guests attending. The program featured a symposium on the subject "Flameproofing Textiles," with the following panel of speakers: Herman E Hager; Cameron A Baker, U S Testing Co; and Maurice Fishman, Lee Dyeing Co.

—♦ ♦—

### Mid-West

THE Mid-West Section will hold its next regularly scheduled meeting on October 30th at the Bismarck Hotel, Chicago, Ill.

## NOTICE TO SECRETARIES AND PUBLICITY CHAIRMEN OF LOCAL SECTIONS

Papers presented before local sections should be sent to Dr Carl Z Draves, Editor of the *Proceedings*, 30 Lahey Street, New Hyde Park, New York. Authors should provide two copies for this purpose.

Reports of local section meetings should be sent to the American Dyestuff Reporter with copies going to Dr H C Chapin, National Secretary.

Dates of meetings and advance notices of meetings should be sent to the American Dyestuff Reporter with copies also going to Dr Chapin. For publication in any particular issue, information should be in the office of the Reporter 17 days before the issuance date.

# WASHINGTON FIRST IN 15TH INTERSECTIONAL CONTEST

THE Washington Section, in its initial year of competition, was judged the winner of the 15th Intersectional Contest, which was held on September 18th in Atlanta, Ga, as one of the featured events of AATCC's 33rd National Convention. An annual competition, the Intersectional Contest pits the research committees of the participating Sections, which work throughout the year in the preparation of research papers on current topics of interest to the industry.

This year's winner, "Soiling of Fabrics in Contact with the Skin," presented for the Washington Section by its committee chairman Daniel Frishman, Harris Research Laboratories, topped six other entries from other Sections.

Second-place honors went to the Piedmont Section for its paper "Effect of Various Softeners on a Resin-treated Viscose Rayon Fabric," while the Rhode Island Section, a perennial prize-winner, took third place with its entry, "An Investigation of the Properties of Cyanoethylated Cotton." Edward A Murray, consultant, delivered the Piedmont Section paper, and W George Parks, Univ of Rhode Island, served as speaker for the Rhode Island Section.

Additional papers presented in the '54 competition were as follows: "A Search for Factors Influencing the Crockfastness of Cotton"—New York Section (P J Fynn, J C Penney Co, *speaker*); "Studies on the Acceptability and Perceptability of Fading"—Northern New England Section (Charles A Lermond, Fabric Research Laboratories, Inc, *speaker*); "Factors affecting Tint Removal from Staple Fibers"—Philadelphia Section (Robert J Thomas, E I du Pont de Nemours & Co, Inc, *speaker*); and "Modification of Urea-formaldehyde and Melamine-formaldehyde Crease-resistant Finishes with Nitrile Latices"—Southeastern Section (Edward Abrams, Southern Research Institute, *speaker*).

The decision of the judges regarding the contest winners was announced by Frank J O'Neil, Pacific Mills, chairman of the Intersectional Contest, at the Association's annual banquet on Saturday evening, September 18th, in the Exhibition Hall of the Atlanta Biltmore. The honors were accepted by Mr Frishman; R Hobart Souther, Cone Mills Corp, representing the Piedmont Section; and James R Redmond, Interchemical Corp, chairman of the Rhode Island Section committee.

Chief justice of this year's contest was Roland E Derby, The Derby Co, Inc. He was assisted by the following judges representing sections: *Hudson-Mohawk*—Howard C Woodruff, General Electric Co; *Mid-West*—Frank F Myers, Geigy Co, Inc; *New York*—Edward D Lind, Ciba Co, Inc; *Northern New England*—George O Linberg, Synthron, Inc; *Pacific Southwest*—George M Moisson, Jr, California Hand Prints; *Philadelphia*—Virgil T Hartquist, Jefferies Processors; *Piedmont*—Neal A Truslow, U S Rubber Co; *Rhode Island*—Maurice R Fox, Imperial Chemical Industries, Ltd & Arnold, Hoffman & Co, Inc; *South Central*—Charles B Ordway, American Aniline Products, Inc; *Southeastern*—Curt Mueller, Bibb Mfg Co; *Washington*—Alfred R Macormac, Agricultural Research Center; *Western New England*—Thomas J Gillick, Jr, American Felt Co.

## INTERSECTIONAL CONTEST OFFICIALS

**Photo at right shows 1954 Contest Committee——Seated (l to r): John M Gould, Barre Wool Combing Co; Frank J O'Neil, Pacific Mills, chairman; Thomas R Smith, Wiscassett Mills Co. Standing (l to r): Robert F Brown, Emery Industries, Inc; Earle D McLeod, Arnold, Hoffman & Co, Inc, secretary; and Kenneth A Howry, Daily News Record**

**Judges are pictured in photo below ——Seated (l to r): Hartquist, Linberg, Derby, Gillick, Moisson. Standing (l to r): Mueller, Fox, Truslow, Macormac, Ordway and Lind**

## 1954 National Convention and "The South's First Textile Wet Processing Exhibit"——

# Registration at Atlanta Convention Exceeds 1600

ALL roads and airlines led to Atlanta, Georgia, last month for 1639 AATCC members and guests as the Association convened at the Atlanta Biltmore, site of the 33rd National Convention and The South's First Textile Wet Processing Exhibit.

Under the auspices of the Southern Region, comprising the Piedmont, South Central, Southeastern, and Washington Sections, the Association met in Atlanta for its second convention in that city in sixteen years. This was by far the South's most ambitious undertaking in AATCC convention annals—a four-day affair commencing Wednesday, September 15th, and continuing through Saturday, the 18th. Nine Atlanta hotels were used to house members and guests, with shuttle bus service provided between eight of them and the headquarters Atlanta Biltmore.

Approximately 65 exhibitors, occupying the Biltmore's 15,000-sq ft exhibition hall for the first three days of the event, attracted a goodly number of viewers, including a high percentage of mill executives, dyers and finishers, and research and testing personnel.

Highlights of the 33rd Annual Meeting included the technical program of five symposia and the 1954 Intersectional Contest; the annual Olney Medal and Alumni Luncheons; the Annual Banquet; a diversified entertainment program, featuring the AATCC golf tournament and a football game between Georgia Tech and Tulane; and a full program for lady guests.

The Council met for its 193rd session during the Convention, as did several of its standing committees. However, a scheduled meeting of the Technical Committee on Research had to be postponed because of conflicting schedules. Other meetings of note included the Annual Business Meeting on Wednesday, and a meeting of the Perkin Centennial Executive Committee and subcommittee chairmen on Friday.

An advance registration of 1400 eased the burden of the Registration Committee, which "opened for business" on Tuesday evening.

All Convention papers, as well as official transcripts of the Olney Medal Award Luncheon will be published in future issues of the American Dyestuff Reporter.

Registration begins for more than 1600 members and guests

A view of part of the exhibit area

## WEDNESDAY—EXHIBITORS' DAY

Wednesday, Sept 15, was designated "Exhibitors' Day," as the Exhibition Hall was opened to viewers at 9:00 am.

The Council held its regularly scheduled meeting in the morning, at which time it approved a new corporate membership drive towards a goal of $72,000 annual operating income for the support of AATCC research activities at the Lowell laboratories. It was announced at the meeting that Walter F Fancourt III, Walter Fancourt & Co, would be general chairman of next year's convention in Atlantic City, N J, Sept 21-23. Mr Fancourt previously served in the same capacity for the 1949 convention, which was also held in Atlantic City.

The technical program for the day featured an afternoon symposium on "Preparation and Dyeing of Textiles," with Walter M Scott, U S Dept of Agriculture, presiding. The following papers were presented:

"Desizing Procedures in Relation to Enzyme Evaluation"—Hector C Borghetty and John T Taylor, Rohm & Haas Co

"Sources of Color in Cotton"—Simon A Simon and Carlyle Harmon, Chicopee Manufacturing Corp

"Some Notes on the Technology of the Single-Stage Continuous Bleaching Process"—Thomas E Bell, H D Terhune and M H Rowe, E I du Pont de Nemours & Co, Inc

"Spun Colored Fibers"—Geoffrey V Lund, Courtaulds (Alabama) Inc

"A Progress Report on the Bond Processing Machine"—Karl Rupenthal, Pittsburgh Coke & Chemical Co

The initial event of the Ladies Program took place on Wednesday afternoon with a Welcome Party in the Biltmore's Empire Room.

As previously noted, the Annual Business Meeting was also held on Wednesday afternoon with AATCC president J Robert Bonnar presiding. Among the items of business was the approval of the newly organized Western New York Section.

## THURSDAY—CORPORATE MEMBERS' DAY

Corporate Members, those firms whose contributions finance the work of AATCC's permanent research staff at Lowell, were received on Thursday—Corporate Members' Day, and many representatives availed themselves of the opportunity to sit in on the morning symposium on "Dyeing of Textiles," over which Kenneth S Campbell, North Carolina State College, presided. They heard the following presentations:

"The Influence of Temperature on Vat Dye Application"—Maurice R Fox, Imperial Chemical Industries, Ltd

"A Study of Carriers in Dyeing Dacron Polyester Fiber"—Charles L Zimmerman, J M Mecco and A J Carlino, American Cyanamid Co

"Acrilan Dyeing"—Walter H Hindle, Chemstrand Corp

OLNEY MEDAL AWARD—Corporate Member representatives were special guests at the traditional Olney Medal Award Luncheon at noon when William D Appel, National Bureau of Standards, became the 11th recipient of the Association's highest award. Samuel L Hayes, Ciba Co, Inc, presiding, and C Norris Rabold, Erwin Mills, Inc, welcomed them and expressed gratification for the impressive turnout.

The Olney Medal was presented to Mr Appel by President Bonnar, and tribute was paid Mr Appel's technical and scientific achievements by Dr Wallace R Brode, associate director of the National Bureau of Standards.

Concurrent with the Olney Medal Award Luncheon was the Ladies' Luncheon at the Capital City Country Club.

An afternoon symposium on "Finishing of Textiles, with Leonard Smith, National Cotton Council, presiding, featured the following papers:

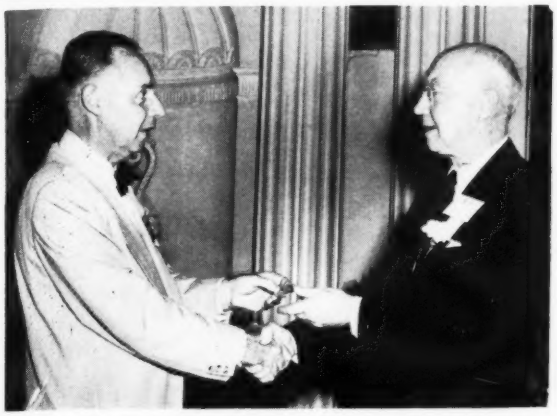
"Application of THPC Flame-Retardant Process to Cotton Fabrics"—John D Guthrie, George L Drake, Jr and Wilson A Reeves, Southern Utilization Research Branch, U S Department of Agriculture

"Wrinkle-Resistant Treatment of Cotton"—Theodore F Cooke, American Cynamid Co

## HEAD TABLE—OLNEY MEDAL AWARD LUNCHEON

*(L to r):* **Harold W Stiegler, AATCC director of research; Albert E Sampson, National Aniline Div, treasurer; Charles W Dorn, J C Penney Co, chairman, Technical Committee on Research; Leonard S Little, chairman, Executive Committee on Research; Henry A Rutherford, North Carolina State College, chairman, Olney Award Committee, and chairman, Piedmont Section; Albert E Johnson, National Institute of Drycleaning, chairman, Corporate Membership Committee; C Norris Rabold, Erwin Mills, Inc, past president; William D Appel, National Bureau of Standards, 1954 Olney Medalist**

*(L to r):* **Samuel L Hayes, Ciba Co, Inc, vice president (Southern Region) and toastmaster; W R Brode, National Bureau of Standards, who spoke on "The Medalist—The Scientist"; J Robert Bonnar, General Dyestuff Co, president; Merrill C Loftin, Dept of Commerce; C Russell Gill, Southern Sizing Co, convention chairman; Rev John Easias, Peachtree Methodist Church; Harold C Chapin, secretary**



**President J Robert Bonnar (left) presenting the 1954 Olney Medal to William D Appel**

"Nitrile Latices—A New Concept in Textile Finishing"—Neil H Sherwood, B F Goodrich Chemical Co

"Antistatic Action vs Molecular Structure"—Geoffrey R Ward, General Aniline & Film Corp

"Finishing of Fabrics from Synthetic Fibers"—John H Andreen, E I du Pont de Nemours & Co, Inc

## EVENTS OF FRIDAY

Concurrent technical sessions featured Friday morning's program with symposia on "Printing of Textiles" and "Waste Disposal Problems of Southern Textile Mills." These were respectively presided over by Raphael E Rupp, Southern Dyestuff Corp, and R Hobart Souther, Cone Mills Corp.

The following papers relative to printing were presented:

"Fast Color Printing"—Raymond W Jacoby, Ciba Co, Inc

"New Development in Vat Dye Printing"—Arthur K Saville, E I du Pont de Nemours & Co, Inc

"The Use of Resins in Producing Colored Three-Dimensional Styles on Cotton Fabrics"—Robert H Phillips and Edward W Lawrence, Cranston Print Works

"Printing and Related Operations on Glass Decorative Fabrics"—Remus F Caroselli, Owens-Corning Fiberglas Corp

Six papers featured the symposium on waste disposal problems as follows:

"Cotton Slashing with Synthetic Compounds as a Means Toward Pollution Abatement"—Duane W Snyder, Crompton-Shenandoah Co

"Treatment of Sulfur, Vat and Other Dye Wastes with Carbon Dioxide and Flue Gases"—Harold R Murdock, Harold R Murdock Associates

"Relation of Federal Stream Pollution Laws to Industry"—Lewis A Young, U S Public Health Service

"Biological Treatment of Highly Alkaline Textile Mill Waste-Sewage Mixtures"—T A Alspaugh and R H Souther, Cone Mills

"Studies on Textile Waste Disposal"—D F Smallhorst, Texas State Department of Health

"Bleachery and Dyehouse Waste Studies"—John L Brown, Jr, Cannon Mills Co

The following panelists joined the speakers in a discussion following the presentation of the six papers: W R Steele, Semet-Solvay Div, Allied Chemical & Dye Corp; W H Weir, Georgia State Dept of Health; E C Hubbard, N C Stream Pollution Control Authority; G A Rhame, Water Pollution Control Authority, South Carolina State Board of Health; and E A Leonard, textile industry representative, National Technical Task Committee on Industrial Wastes, Alexander Smith, Inc.

Alumni of the various textile colleges met at noon Friday for the annual Alumni Luncheon, with Herman A Dickert, director of Georgia Tech's A French Textile School, presiding. Featured speaker at this affair was Dr L H Hance, president of the Institute of Textile Technology and vice president, National Council of Textile Education, who cited the continuing responsibility of textile college alumni to the colleges and their undergraduates. Dr Hance pointed out that there are more graduates of textile colleges who are members of AATCC than any other textile association.

Other speakers at the Luncheon included Arthur T Brainerd, Ciba Co, Inc, who gave a progress report on the Student Paper Contest; Charles W Dorn, chairman of AATCC's Technical Committee on Research; and representatives of several of the textile colleges who brought greetings from their respective institutions. A prepared statement was read by Prof Percival Theel, Philadelphia Textile Institute, for Bertrand W Hayward, president of the NCTE, who was unable to attend.

## HEAD TABLE—ALUMNI LUNCHEON

*Seated (l to r):* **Lloyd W Chapin, dean, Georgia Institute of Technology; Arthur T Brainerd, Ciba Co, Inc, chairman, Student Contest Committee; L H Hance, Institute of Textile Technology, vice president, National Council of Textile Education; Herman A Dickert, director, A French Textile School, Georgia Institute of Technology; Percival Theel, Philadelphia Textile Institute, chairman, Publications Committee; Paul G Wear, Penick & Ford Ltd, Inc, assistant convention chairman**

*Standing (l to r):* **Elmer E Fickett, retired head of the Chemistry Dept, Lowell Technological Institute; Hugh M Brown, dean, Textile School, Clemson College; Charles W Dorn, J C Penney Co, chairman, Technical Committee on Research; P J Wood, Royce Chemical Co, representing Fairleigh Dickinson College; Cleveland L Adams, School of Textile Technology, Alabama Polytechnic Institute; George R Griffin, head, Chemistry Dept, Lowell Technological Institute**

Afternoon social activities on Friday included the AATCC golf tournament at Standard Town and Country Club, and sightseeing tours of Atlanta, including the Cyclorama, Stone Mountain, Georgia Tech, etc.

The golf tournament, under the chairmanship of George Dozier, Southern Dyestuff Corp, attracted over 100 entrants. Top honors went to Richard Rendleman, Proctor Chemical Co, who shot a par 72 low gross. John Ferguson, Blackman-Uhler Co, had a low net of 65; Henry Dozier, Nyanza Color & Chemical Co, won the blind bogey competition; and J R Hopkins, Becco Sales Corp, won the prize for being closest to the pin on the 11th hole.

## EVENTS OF SATURDAY

Saturday's feature events were the '54 Intersectional Contest (details of which appear elsewhere in this issue), the Football Buffet Luncheon, the football game between Georgia Tech and Tulane, and the Annual Banquet.

A large group of AATCC conventioneers joined a "shirt-sleeve" crowd at Grant Field to watch Georgia Tech run roughshod over an inexperienced Tulane eleven.

The Annual Banquet, traditional finale of each Convention, was held in the Biltmore's Exhibition Hall, which was the only facility capable of accommodating the large crowd.

Milton Harris, Harris Research Laboratories, chairman of the Washington Section, served as toastmaster.

C Russell Gill, Southern Sizing Co, convention chairman, was given a rising vote of thanks for his handling of the 33rd Annual Meeting, and he was presented with a watch on behalf of the convention committee by Paul G Wear, Penick & Ford Ltd, assistant convention chairman.

Following the presentation of honored guests, J Robert Bonnar, General Dyestuff Co, presented the President's Address. This was followed by the presentation of the 12th past president's pin to Mr Bonnar by C Norris Rabold, his predecessor in office. Mr Bonnar's two-year term as president expires this year.

Other Banquet proceedings included the presentation of the annual American Dyestuff Reporter Award to Charles L Zimmerman by Prof P Theel, chairman of AATCC's Publications Committee, and the presentation of Intersectional Contest Awards by Frank J O'Neil, Pacific Mills, chairman of the Intersectional Contest Committee.

Guest speaker Warren Foster, The Coca-Cola Co, gave a highly entertaining address, ostensibly as the football coach of Siwash College, before his identity was revealed to the audience.

Walter F Fancourt III, chairman of the 1955 Convention, extended an invitation to all present to attend next year's meeting in Atlantic City, N J.

A program of professional entertainment brought to a close another outstanding AATCC Convention.

J Robert Bonnar delivers the President's Address as Southern regional vice president Samuel L Hayes registers approval

Presentation of Intersectional Contest Awards

Presentation of the ADR Award

AATCC Conventioneers prep for the Georgia Tech-Tulane game at the football buffet luncheon

# HEAD TABLE—ANNUAL BANQUET

(All reading left to right)

*Front:* Arthur R Thompson, Ciba Co, Inc, convention publicity chairman; Mrs Wyss L Barker; H Gillespie Smith, American Cyanamid Co, reservation chairman; Mrs James W Swiney; Joe T Bohannon, Jr, American Aniline Products, Inc, dining chairman; Mrs William B Griffin; Mrs Adam Fisher, Jr; John C Cook, WRC Smith Publishing Co, exhibits chairman

*Rear:* Richard R Frey, assistant secretary; Harold W Stiegler, director of research; Paul G Wear, Penick & Ford Ltd, Inc, assistant convention chairman; Charles W Dorn, J C Penney Co, chairman, Technical Committee on Research; Leonard S Little, chairman, Executive Committee on Research; Henry F Herrmann, General Dyestuff Co, past president; Thomas R Smith, Wiscassett Mills, past president

*Front:* Mrs Paul G Wear; Mrs Walter F Fancourt III; A Kempton Haynes, Rohm & Haas Co, registration chairman; Mrs Thomas R Smith; Mrs Henry F Herrmann; Mrs J Robert Bonnar; Mrs C Russell Gill, Mrs Warren Foster

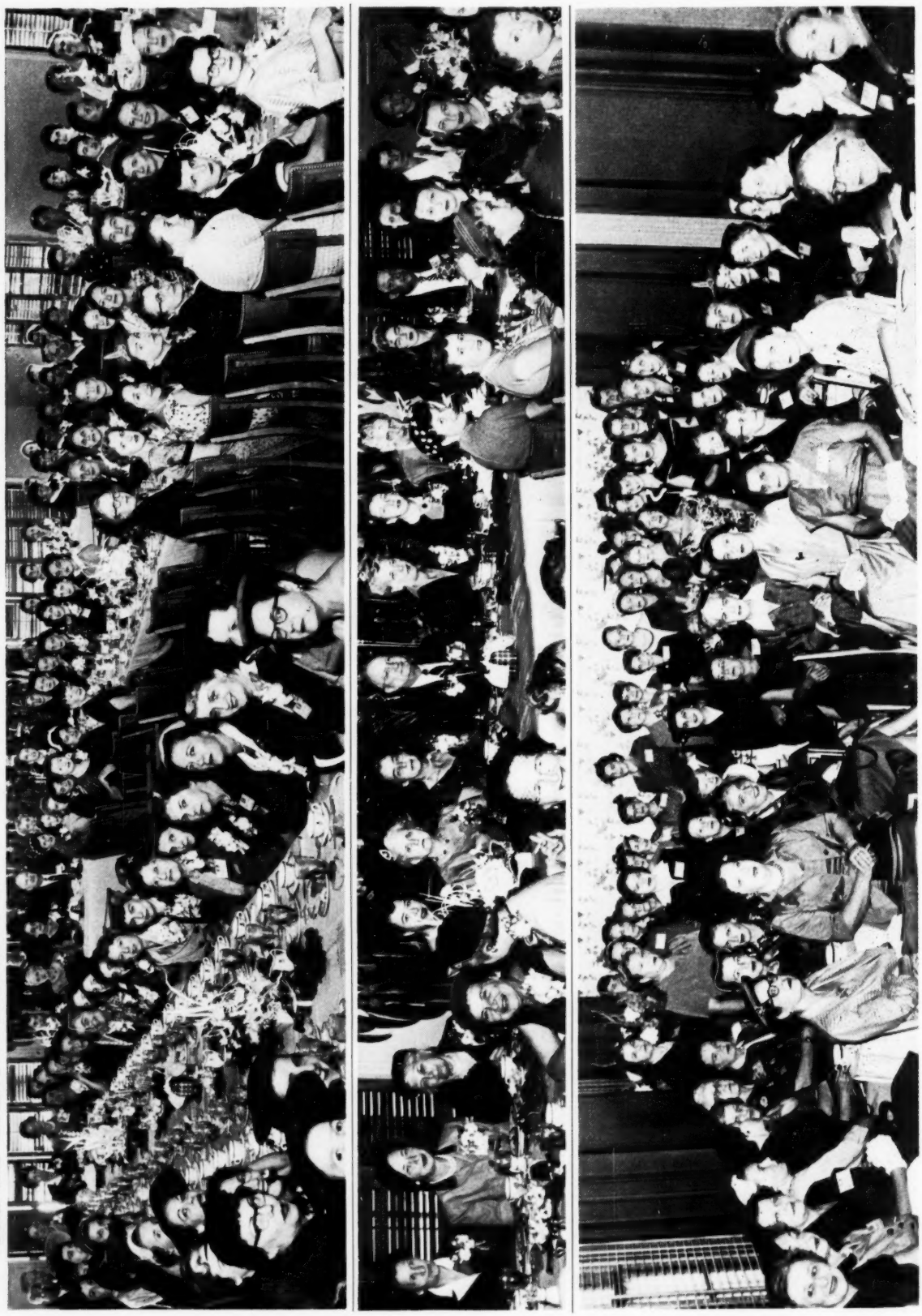
*Rear:* Henry F Herrmann; Thomas R Smith; Percival Theel, Philadelphia Textile Institute, chairman, Publications Committee; Frank J O'Neil, Pacific Mills, chairman, Intersectional Contest Committee; C Norris Rabold, Erwin Mills, Inc, past president; Warren Foster, Coca Cola Co, guest speaker; J Robert Bonnar, General Dyestuff Corp, president; C Russell Gill, Southern Sizing Co, general convention chairman; Samuel L Hayes, Ciba Co, Inc, vice president (Southern Region)

*Front:* Mrs Samuel L Hayes; Adam Fisher, Jr, Du Pont, reception chairman; Mrs C Norris Rabold; Mrs Harold C Chapin; William B Griffin, Dexter Chemical Corp, ladies committee chairman; Mrs Joseph H Jones; Mrs Raymond W Jacoby

*Rear:* Milton Harris, Harris Research Laboratories, toastmaster and chairman; Washington Section; Samuel L Hayes; Joseph H Jones, Phoenix Dye Works, vice president (Western Region); George L Baxter, Bradford Dyeing Assoc, vice president (Central Atlantic Region); George O Linberg, Synthron, Inc, vice president (New England Region); P J Wood, Royce Chemical Co, past president; T Howard McCamy, Pepperell Mfg Co, chairman, Southeastern Section

*Front:* James W Swiney, Fulton Bag & Cotton Mills, finance chairman; Mrs T Howard McCamy; Mrs A Kempton Haynes; Junius Smith, Clark Publishing Co, printing chairman; Mrs Paul O Anderson; Wyss L Barker, National Aniline Div, Allied Chemical & Dye Corp, transportation chairman

*Rear:* P J Wood; T Howard McCamy; Paul O Anderson, Peerless Woolen Mills, chairman, South Central Section; Henry A Rutherford, North Carolina State College, chairman, Piedmont Section; Albert E Sampson, National Aniline Division, treasurer; Harold C Chapin, secretary; Raymond W. Jacoby, Ciba Co, Inc, chairman, Perkin Centennial Executive Committee; Walter F Fancourt III, Walter Fancourt & Co, 1955 Convention chairman



*and the Ladies at Atlanta . . . .*

# TINCTORIAL STRENGTH, DEPTH (OR APPARENT STRENGTH) OF DYEINGS AND "MONEY VALUE" OF DYES*

I H GODLOVE

*Central Research Laboratory, General Aniline & Film Corp Easton, Pa*

Based on the concept that *apparent strength* or *depth* of dyeing is measured by departure from white in a properly constructed visual color solid similar (but not identical) to the Munsell color solid, a simple empirical formula for calculation of apparent strengths (depths) from Munsell notations has been developed. It has been in fairly successful practice for over two years. The formula has been applied to a number of dyes of several classes and the average relation between ratio of depths and ratio of concentrations has been found for three classes.

In the cases where a dye lot needs to be shaded slightly in mill or plant, it is shown what direction this shading should take to avoid penalizing the product by not bringing about optimum shading to obtain maximum apparent strength.

## INTRODUCTION

THERE are several situations or problems in which a fairly precise knowledge of the strengths of dyeings of competitive dyes is required. When the dyeings are chemically (and perhaps physically) identical, there is no problem, for then the strengths or concentrations on the fiber are proportional to the weighed-out amounts of dye used in dyeing (assuming equal exhausts). But when the standard, competitive, or customer's dyeing is chemically or even physically different in or on the textile fiber, and particularly when the estimate of strength must be made by visual judgments only, then the problem is much more difficult. For then we have all the problems of "metameric" dyeings, with judgments varying with the lighting of the samples and with the individual personal variations of observing eyes, and, in addition, other errors that may be made by nearly all persons, whatever their color vision may be, as will be shown in this paper.

It is general practice in preparing competitive dyeings for fastness tests to make the compared dyeings appear of equal strength before a comparison of the fastnesses of a sample with a standard. The need for this is obvious, since fastness properties vary with strength or concentration of dye. This need and a method of taking care of it were recognized by the recent setting up of a Committee on Standard Depths for Fastness Evaluation by the Amerian Association of Textile Chemists and Colorists. The function of this Committee is to set up standard depths of shade in perhaps a dozen hues for each of the most important fibers. Also, as new dyes are prepared in the synthetic laboratory, the chemist must know the relative strengths of the new dye and his own previous dyes or competitive ones of similar color in order to determine their relative money values. Money values are inversely proportional to the prices per pound, and the amounts of dyes required to match a given shade. As we shall see, these amounts are not necessarily inversely proportional to the quantities of dyestuff per pound of sample.

But further, as new lots of dyes are produced in the plant there are in some cases inevitable slight deviations from standard because of the complexity of the chemical reactions, and the side reactions which accompany the main reactions. This makes it frequently necessary to shade the slightly off-standard dye lot with small amounts of a dye of very similar properties but color just different enough to bring the lot to a standard shade. This shading process may sometimes result in a loss of apparent strength, or depth of dyeing. Clearly, accurate objective measures of relative strength can be of much help to prevent the producer from penalizing his product by not effecting optimum shading. The principles which are the bases of the method of this paper for assessing apparent strength make it relatively easy to prevent this undesired result. First, however, it is necessary to define more exactly what we mean by *tinctorial strength* (depth of dyeing) and *apparent strength*, or simply *strength* or *depth* of dyeing.

TERMINOLOGY———When a dyestuff sample is practically identical in chemical composition and physical condition (particle-aggregate size, etc) with a standard, the sample and standard will have practically identical colors when the concentrations are equal. When the colors are not identical, it is generally assumed that the deeper color, that is, the darker and more saturated (vivid) color, corresponds to greater concentration of dye on the fiber. It is well known, however, that there is no direct proportionality between depth of dyeing and concentration. The more concentrated dyeing is regarded as of greater strength and depth. But these terms have never been defined precisely enough to determine experimentally any simple relation between depth or strength and concentration.

The situation is much more complicated when the sample and standard or competitive type are not of practically identical composition and physical condition. In this case we wish to know the relative effectiveness of the sample and standard in producing a given color. If x parts of sample match the color produced by $x + y$ parts of standard, the sample is said to be stronger than the standard in the ratio $(x + y)/x$, that is, in inverse proportion to the amount required for match. If the cost per pound of sample and standard are equal, the sample is said to have a money value greater than standard in the proportion $(x + y)/x$. In making these judgments, the dyer or colorist does not limit himself to comparison of chemically similar types. It is only necessary that the samples compared at certain concentrations have approximately matching colors, or that they are at least of equal *depth*, though sample and standard may differ appreciably in shade (hue). Thus, while *strength* is originally and ideally equivalent to concentration of dyestuff on the textile fiber, in actual practice it is a subjective estimate, made visually, as judged by related variables, which change when concentration changes. That its determination is subject to fairly large errors under certain conditions has been pointed out several times and known for many years (1).

A decade ago colorists of Imperial Industries (2) proved that, when small percentages of a dye were replaced by equivalent amounts of gray dye and compared with undulled standards, even their eight most expert colorists made errors of 3-11% in their visual or subjective judgments of strength. Strangely, twelve less experienced noncolorists made better scores, being less disturbed in their judgments by grayness, although the experts were more consistent in repeating their

* A contribution to the *Proceedings*.

## TABLE I

## TINCTORIAL STRENGTHS-HUE CORRECTION

*Multiply values in last column by chroma C to obtain "hue correction" in apparent strength* $A = \sqrt{16\,v^2 + C^2} + .025C\ (\Delta H_{10PB})$ *where* $v = 10 - V$

| Munsell Hue Notation | | | | Munsell Hue Notation | | | |
|---|---|---|---|---|---|---|---|
| *Add Tenths* | *Subtract Tenths* | $\Delta H_{10PB}$ | $.025\ \Delta H_{10PB}$ | *Add Tenths* | *Subtract Tenths* | $\Delta H_{10PB}$ | $.025\ \Delta H_{10PB}$ |
| 10 PB | 10 PB | 0 | .000 | 6 R | 4 BG | 26 | .650 |
| 1 P | 9 PB | 1 | .025 | 7 R | 3 BG | 27 | .675 |
| 2 P | 8 PB | 2 | .050 | 8 R | 2BG | 28 | .700 |
| 3 P | 7 PB | 3 | .075 | 9 R | 1 BG | 29 | .725 |
| 4 P | 6 PB | 4 | .100 | 10 R | 10 G | 30 | .750 |
| 5 P | 5 PB | 5 | .125 | 1 YR | 9 G | 31 | .775 |
| 6 P | 4 PB | 6 | .150 | 2 YR | 8 G | 32 | .800 |
| 7 P | 3 PB | 7 | .175 | 3 YR | 7 G | 33 | .825 |
| 8 P | 2 PB | 8 | .200 | 4 YR | 6 G | 34 | .850 |
| 9 P | 1 PB | 9 | .225 | 5 YR | 5 G | 35 | .875 |
| 10P | 10 B | 10 | .250 | 6 YR | 4 G | 36 | .900 |
| 1 RP | 9 B | 11 | .275 | 7 YR | 3 G | 37 | .925 |
| 2 RP | 8 B | 12 | .300 | 8 YR | 2 G | 38 | .950 |
| 3 RP | 7 B | 13 | .325 | 9 YR | 1 G | 39 | .975 |
| 4 RP | 6 B | 14 | .350 | 10 YR | 10 GY | 40 | 1.000 |
| 5 RP | 5 B | 15 | .375 | 1 Y | 9 GY | 41 | 1.025 |
| 6 RP | 4 B | 16 | .400 | 2 Y | 8 GY | 42 | 1.050 |
| 7 RP | 3 B | 17 | .425 | 3 Y | 7 GY | 43 | 1.075 |
| 8 RP | 2 B | 18 | .450 | 4 Y | 6 GY | 44 | 1.100 |
| 9 RP | 1 B | 19 | .475 | 5 Y | 5 GY | 45 | 1.125 |
| 10 RP | 10 BG | 20 | .500 | 6 Y | 4 GY | 46 | 1.150 |
| 1 R | 9 BG | 21 | .525 | 7 Y | 3 GY | 47 | 1.175 |
| 2 R | 8 BG | 22 | .550 | 8 Y | 2 GY | 48 | 1.200 |
| 3 R | 7 BG | 23 | .575 | 9 Y | 1 GY | 49 | 1.225 |
| 4 R | 6 BG | 24 | .600 | 10 Y | 10 Y | 50 | 1.250 |
| 5 R | 5 BG | 25 | .625 | | | | |

judgments. Both these groups, as well as 18 less expert colorists, had mistaken some dullness for strength, tending to overcompensate for dullness. The present author has previously discussed the significance of these and related findings by others (1).

The ICI workers interpreted the better success of the less experienced observers in terms of greater reliance upon one of the two available objective bases of the subjective (visual) judgments. They were found to depend most upon the reflectance of the dyeing, which is closely related to its lightness or darkness, while the experienced colorists apparently depended more upon "excitation purity"[1], which is related to dyer's "brightness". This difference, coupled with the fact that a given change in concentration usually produces a more readily perceived change in reflectance than in purity, may be the explanation of the anomalous situation reported in the preceding paragraph, though other explanations are possible.

Stearns *(3)*, in a very illuminating paper discussing these questions, states that "Colorists have little difficulty agreeing within 5% strength when there is no shade difference, but as the shade difference increases the opinions vary more and more until finally a strength comparison becomes worthless". But in the ICI work we have seen that errors arise not only with shade (hue) differences but with brightness or dullness differences between sample and standard. Hue and brightness taken together may be included in the term "chromaticity" (more exactly, their psychophysical correlates are so included). Chromaticity differences may be present whenever the chemical or physical nature of the sample and standard are appreciably different. Such differences are in general accompanied by differences in spectral reflectance curves, and such curves can be used to interpret and predict to some extent the nature and degree of the shade (hue), brightness and strength differences which may be expected. It is the main purpose of this paper to present a simple way of computing strengths from the Munsell notations of the colors, which in turn may be obtained from spectrophotometric measurements or, less precisely, from simple comparisons with Munsell charts.

## MUNSELL CONCEPTIONS IN EXPRESSING DEPTH OF COLOR

APPARENT STRENGTH ("DEPTH")———The "strength" *of a dyeing*, as ordinarily used, refers to the ratio of dye in the dyebath to the weight of the fabric dyed. It is tacitly assumed that the exhaustion is good enough that this ratio is practically the same as the ratio of dye on the textile fiber to the weight of fiber. The strength *of a dye* is the reciprocal of the strength of the dyeing of that dye which is required to produce the desired color. But we have seen above that the strength of a dye is ordinarily estimated by visual judgments with the unaided human eye, a process subject to certain errors. But a dye is a material substance; color is a visual perception. For the moment we wish only to note that the strength *of a color* is a perceptual quality, and, following Deane B Judd of the National Bureau of Standards, we may define the strength of a color as the "perceptual quality associated with the amount of dye used to produce the color"*(4)*. To make these conceptions more definite, we now define "apparent strength" (depth) A as the quantity defined by the following semiempirical equation, which has been found to yield measures of strength similar to those of direct visual judgments, and very useful in practice.

$$S = (16\,v^2 + C^2)^{1/2} \text{ ("uncorrected")} \quad (1)$$

$$A = S + .025\,C\,(\Delta H_{10PB}) \text{ ("corrected")} \quad (2)$$

where H and C refer to the Munsell hue and chroma of the color respectively, v is the Munsell value measured downward from ten ($= 10 - V$, where V is the value, and $\Delta H_{10PB}$ is the least number of hue steps, on the Munsell 100-step scale, by which the hue of the color differs from Munsell 10PB. Values of $.025\Delta H_{10PB}$ are given in Table I. Since S is the square root of the sum of two squares, it may be found in about thirty seconds by a graphical method, described below, which consists merely in measuring the hypotenuse of a right triangle, the sides of which are C and 10-V, with the scale for 10-V being four times as great as the scale for C. The *correction factor for hue*, which is added to S, can be found by using Table I and a simple slide-rule multiplication, or graphical method may be used here too.

THE NATURE OF APPARENT STRENGTH (DEPTH) AND DATA TO DETERMINE IT———The two equations (1 and 2) may of course be written as one. They were written separately to emphasize "hue correction", which had to be introduced to make the equations successful. The primary conception on which they are based is that *"apparent strength" is strictly a visual quantity which measures*, as more and more dye is put on a "white" fiber, *how far the color departs from white in a 3-dimensional color space* similar to that of the Munsell color system. The stronger the dyeing, the farther from the white point is the point representing its color. Stearns *(3)* and Judd *(4)* have pictured the paths in the color solid followed by the colors of increasing strength. In general the paths are curved, but we are here not concerned with the path by which a given color is reached. We need to know only the exact specification of the color (where its representa-

[1] *Excitation purity* measures the relative distance, on the standard "color triangle" (CIE chromaticity diagram), of the point representing the given color to the point representing gray. In an experimental instrumental sense, it parallels the proportion of homogeneous spectral light, in the mixture of this light with white light, which is required to match the given color.

## TABLE II

### APPARENT STRENGTHS OF WOOL DYES*

| Concn % | Dye | Munsell Notation Hue | Value | Chroma | Apparent Strength A |
|---|---|---|---|---|---|
| 2 | Supranol Brilliant Red BA-CF | 2.5 R | 3.5 | 13.0 | 40.1 |
| 2 | Fast Light Red BA | 2.6 R | 3.7 | 13.5 | 36.2 |
| 2 | Azo Phloxine GA Ex Conc | 4.3 R | 3.9 | 14.2 | 36.8 |
| 2 | Brilliant Croceine 3BA | 7.3 R | 3.8 | 14.7 | 38.8 |
| 2 | Scarlet RRA New | 7.6 R | 4.5 | 15.0 | 37.0 |
| 2 | Acid Anthracene Red GD Ext | 8.5 R | 4.6 | 15.5 | 37.6 |
| 2 | Supranol Brown 5RN Ext | 8.5 R | 3.1 | 9.6 | 36.0 |
| 2 | Orange RO Ex Conc | 9.5 R | 5.0 | 15.5 | 36.7 |
| 2 | Supranol Orange RA Conc | 9.6 R | 4.7 | 13.9 | 35.6 |
| 2 | Acid Orange XX | 0.3 YR | 5.6 | 16.2 | 36.2 |
| 2 | Supramine Brown RWN | 1.9 YR | 2.3 | 2.5 | 32.9 |
| 2 | Fast Light Orange GA Conc | 3.0 YR | 6.2 | 16.6 | 36.2 |
| 2 | Amido Yellow EA-CF | 5.0 YR | 5.0 | 10.1 | 31.2 |
| 2 | Sulphon Yellow RS Ext | 2.3 Y | 7.7 | 13.5 | 30.6 |
| 2 | Naphtol Yellow SXX New | 4.8 Y | 7.7 | 14.4 | 33.2 |
| 2 | Fast Light Yellow GGX Conc | 5.5 Y | 7.7 | 12.4 | 29.5 |
| 2 | Brilliant Sulphon Flavine FFA** | 0.5 GY | 8.5 | 14.5 | 33.6 |
| 3 | Naphtol Green B | 7.5 GY | 3.0 | 4.5 | 33.1 |
| 3 | Alkali Fast Green 10 GA | 4.7 G | 3.7 | 9.1 | 34.7 |
| 2 | Naphtaline Green V Ext Conc | 8.3 G | 3.0 | 8.0 | 35.5 |
| 2 | Guinea Green BA Ex Conc | 2.5 BG | 3.2 | 8.1 | 34.0 |
| 2 | Anthralan Green GG-CF | 2.5 BG | 3.6 | 5.2 | 29.7 |
| 2 | Neptune Green SGXA | 8.0 BG | 3.2 | 8.0 | 32.8 |
| 2 | Alizarine Cyanine Green GHN Ext | 8.8 BG | 2.7 | 4.8 | 32.2 |
| 2 | Alizarine Cyanine Green EF New | 9.0 BG | 3.4 | 4.7 | 29.3 |
| 1 | Patent Blue AF Ex Conc | 3.5 B | 3.4 | 10.0 | 32.3 |
| 1.5 | Alizarine Fast Grey BBLW | 5.5 B | 2.7 | 2.0 | 30.0 |
| 5 | Naphtylamine Black 10 BR Conc CF | 5.5 B | 1.1 | 0.5 | 37.8 |
| 1.5 | Patent Blue VF Ex Conc | 7.2 B | 3.3 | 9.2 | 31.2 |
| 5 | Sulphon Cyanine Black BA New | 10.0 B | 1.2 | 0.7 | 35.2 |
| 2 | Alizarine Direct Blue AGG | 5.3 PB | 3.1 | 8.5 | 29.9 |
| 2 | Alizarine Blue SAP | 5.6 PB | 2.3 | 7.1 | 32.4 |
| 2 | Alizarine Sky Blue BS | 6.3 PB | 2.5 | 8.9 | 32.2 |
| 2 | Alizarine Supra Sky RA | 8.4 PB | 2.8 | 11.0 | 31.2 |
| 1.5 | Alizarine Irisol RD | 9.0 PB | 2.1 | 10.2 | 33.5 |
| 1 | Acid Violet 6BNOO | 9.0 PB | 1.7 | 11.5 | 35.4 |
| 2 | Formyl Violet S3BA | 9.7 PB | 2.1 | 11.7 | 33.8 |
| 2 | Acid Violet 4RD | 2.3 RP | 3.2 | 10.3 | 32.3 |
| 1 | Violamine RR | 4.7 RP | 3.8 | 9.6 | 30.1 |
| 1.5 | Alizarine Rubinol R | 6.0 RP | 4.4 | 13.8 | 31.8 |
| 1.5 | Alizarine Rubinol GW | 7.0 RP | 4.3 | 12.6 | 31.5 |
| 0.5 | Rhodamine 6G Ex** | 10.0 RP | 5.0 | 15.0 | 32.5 |
| | | | | Average | 33.63 |

* See General Dyestuff Company's sample book "Acid Dyes on Wool" (GDC 241).
** The strong fluorescence of this sample may have introduced error.

tion is in the color solid) and thus how far away from white it is. (*White* is defined more carefully below.

This conception of the nature of apparent strength was arrived at by the author many years ago in a general sense seemed the only logical idea of its nature which could be entertained. But, unfortunately, when put to the test in its original, unmodified form, it did not work successfully. Some two or three years ago, further thought led to modification in the form of the correction factor for hue (shade) given in equation 2. It was recalled that, as seen in other fields, there is a fundamental difference between yellows, on the one hand, and blues and purples on the other. The yellows of nature, pigments and dyes are all light, and as their concentration is increased, darken almost imperceptibly, remaining light as long as they remain typical yellows. The typical blues and purples are dark, and change in lightness considerably with change of concentration. Lack of space prevents presentation of the reasoning leading to the correction of our equation to take account of this, and we shall present it merely as an empirical correction added "to give the correct answer".

## TABLE III

### APPARENT STRENGTHS OF THE IG HILFSTYPEN

| Color | On Wool: Munsell Notation Hue | Value | Chroma | Apparent Strength A | On Cotton: Munsell Notation Hue | Value | Chroma | Apparent Strength A |
|---|---|---|---|---|---|---|---|---|
| yellow | 5.4 Y | 8.08 | 10.5 | 24.95 | 8.0 Y | 8.39 | 10.0 | 23.95 |
| orange | 4.9 YR | 6.63 | 13.8 | 31.35 | 4.0 YR | 5.92 | 12.6 | 31.30 |
| brown | 3.3 YR | 3.65 | 4.3 | 29.35 | 6.8 YR | 3.14 | 2.5 | 29.85 |
| red | 5.7 R | 4.87 | 14.0 | 33.85 | 5.0 R | 3.90 | 11.4 | 34.05 |
| red purple | 7.5 RP | 3.73 | 12.4 | 33.40 | 7.9 RP | 3.37 | 10.0 | 32.80 |
| purple | 6.2 P | 2.94 | 7.9 | 30.55 | 3.5 P | 2.69 | 7.0 | 30.65 |
| light blue | 2.4 PB | 3.91 | 8.1 | 27.20 | 6.2 PB | 3.30 | 8.2 | 28.80 |
| moderate blue | 1.0 PB | 2.62 | 4.3 | 30.80 | 5.6 PB | 2.38 | 5.3 | 31.50 |
| dark blue | 9.2 PB | 1.30 | 1.9 | 34.90 | 9.2 PB | 1.67 | 2.0 | 33.45 |
| green | 7.1 BG | 5.56 | 7.8 | 23.90* | 0.9 BG | 3.24 | 4.4 | 30.60 |
| bluish gray | 4.0 PB | 2.39 | 1.9 | 30.80 | 2.5 PB | 2.76 | 2.2 | 29.45 |
| bluish black | 5.0 PB | 1.25 | 0.3 | 35.05 | 8.0 B | 1.40 | 0.2 | 34.45 |
| reddish black | — | — | — | — | 8.5 RP | 1.52 | 0.4 | 34.15 |

* Obviously faded, as judged by other samples studied since this paper was written.

The correction term, .025 C ($\Delta H_{10PB}$), is so arranged as to be a minimum for 10PB where the darkest strong colors are commonly met, and a maximum for 10Y, where the lightest strong colors commonly occur. The constant .025 was chosen to make yellows, blues, purples and colors of intermediate hue all yield roughly constant strengths at the higher of two concentrations at which they are presented in dye manufacturers' sample books, for example, at roughly 2% of standardized dye for acid wool dyes. In Table II it is seen that 43 acid dyes shown in General Dyestuff Company's pattern card "Acid Dyes on Wool" (GDC 241) vary in apparent strength only from about 30 to about 40, while concentration varies from 0.5% to 5%, although even a black and a gray are included; that is only a 33% depth variation with a 1000% concentration variation. Moreover, those having values of A near 30 looked weaker than average (33.6), and those rating near 40 look stronger than average to the author and to a few other persons to whom the sample book was shown. It therefore seems obvious that an attempt was made originally to exhibit the stronger dyeings at constant apparent strength, which averages about 33.6.

Similar data were found for other dyes. For 32 direct cotton dyes, varying in concentration from 1 to 8%, the apparent strength A varied only from about 20 to about 35. Here the average was about 31 for dyes rated as rapidly or moderately exhausting and about 27 for those rated as slowly exhausting. For 25 Palatine Fast Dyes, varying from 1.5% to 6%, A varied only from 24 (for a yellow) to 37 (for a black). In general here too, where the values of A were high, the dyeings looked somewhat stronger than average, and vice versa.

The strong suggestion of these data was made much more definite by measurements on two early prewar sets of IG tinctorial-strength standards ("Hilfstypen"), one for acid wool dyes and the other for direct cotton dyes, kindly made available to the author by Hans Luttringhaus of General Dyestuff Company. These had been very carefully protected by Luttringhaus, and it appeared probable that all but one of the 25 dyeings, the wool green, had been well preserved[2]. This was suggested by the facts that only this green was out of line with the others and that an American copy of the standards had the green ap-

[2] Since the above was written, the author has seen two or three other exemplars of the wool green Hilfstype which were quite "in line" with the other 24 samples. The chairman of the AATCC Standard Depth Committee, M Babey, delivered to the author two sets of European Standard Depth samples, which were found by spectrophotometric measurement and application of equations 1 and 2 to be fairly constant in depth and in good agreement with the IG samples.

preciably stronger than the IG one, while the *other strengths* were fairly constant. The two yellows were also somewhat weak, but this may have been either intentional or due to the author's failure to make the hue correction large enough. The apparent strengths of the 13 cotton and 12 wool types are given in Table III. The mean deviation from the average (A = 31.1) for the cotton dyes, not including the yellow, is only 5.4%; for the wool dyes, not including the yellow or green, it is 7.0%. Including all 25 colors, the average deviations become 6.7% and 10%. It was stated on the Hilfstypen cards that their samples were intended to show the strengths at which fastness ratings were made. These obviously would be most satisfactory if all were at comparable strengths.

A third source of data came from measurements and calculations of A values on dyed paper samples. Three series of 14 dyeings each were prepared by very experienced paper dyers, the intention being to prepare a light, medium and dark (heavy) dyeing of each dye, with constant strengths within each series. The average values of A for the three series were 11.0, 20.2 and 25.0, respectively. Mean deviations from these averages were as follows: light, 8.4%; medium, 9.4%; and dark, 7.7%.

Since the formula for A was developed, it has been applied in several scores of practical cases and has been found at least adequate for the purposes intended. No doubt its success may be attributed to the fact that it is always applied over a fairly small range. That is, the formula is applied to sample and standard not greatly different from each other in apparent strength or in the attributes of the colors compared. Whatever errors are made, they are apt to be of similar magnitude and direction, hence largely cancel. The constants 16 and .025 in particular may be somewhat poorly chosen and yet introduce no serious error.

## RELATION BETWEEN APPARENT STRENGTH AND CONCENTRATION

——Several formulas have been developed for the functional relation of the reflectance of dyeings to concentration, and these have been discussed by Stearns *(3)*. Reflectance determines Munsell value, and this, according to equation 1, largely determines A. In many cases a knowledge of A alone is sufficient. If the A of sample and standard are nearly equal, we may have all the information we need. But in general we wish to know to what relative *apparent concentrations* the A values correspond. The data bearing on this relation for different classes of dyes are assembled in Table IV. In this table we give the ratio of apparent strengths obtained when the strength of a dyeing is changed in a given ratio, as 4:1

### TABLE IV
### APPARENT STRENGTH A

| Dye | Munsell Hue 1% | Apparent Strength | | Ratio |
|---|---|---|---|---|
| | | 0.5% | 2% | 2%/0.5% |
| *1) Acid Dyes on Wool* | | | | |
| Fast Light Red BA | 1.3 R | 29.69 | 36.22 | 1.22 |
| Azo Phloxine GA Ext Conc | 3.0 R | 31.94 | 36.86 | 1.15 |
| Scarlet 2RA New | 7.4 R | 31.85 | 36.98 | 1.16 |
| Brilliant Croceine 3BA | 7.5 R | 36.90 | 39.95 | 1.08 |
| Sulphon Orange GA | 9.7 R | 33.73 | 36.23 | 1.07 |
| Supramine Brown RWN | 2.5 YR | 26.35 | 32.89 | 1.25 |
| Fast Light Orange GA Conc | 4.0 YR | 30.46 | 36.21 | 1.19 |
| Fast Light Yellow GGX Conc | 6.2 Y | 25.02 | 31.45 | 1.26 |
| Supramine Yellow 3GL-CF | 6.5 Y | 21.90 | 27.40 | 1.25 |
| Milling Yellow H5GA-CF | 9.5 Y | 22.01 | 26.52 | 1.21 |
| Alkali Fast Green 10GA | 5.5 G | 25.80 | 32.80 | 1.27 |
| Naphtaline Green V Ext Conc | 9.5 G | 29.36 | 35.46 | 1.21 |
| Neptune Green SGXA | 7.0 BG | 27.72 | 32.75 | 1.18 |
| Patent Blue VF Ext Conc | 6.0 B | 27.12 | 33.66 | 1.24 |
| Alizarin Blue SAP | 3.8 PB | 26.40 | 32.56 | 1.23 |
| Alizarin Supra Sky GRA | 5.3 PB | 25.27 | 32.66 | 1.29 |
| Alizarin Supra Sky RA | 5.7 PB | 25.31 | 32.72 | 1.29 |
| Anthraquinone Violet 4BF | 8.3 PB | 26.24 | 32.23 | 1.23 |
| Anthraquinone Violet 3RA | 2.5 RP | 27.91 | 33.87 | 1.21 |
| Alizarin Rubinol R | 5.5 RP | 26.11 | 32.97 | 1.26 |
| Supra Light Rubine BLA | 6.2 RP | 28.40 | 35.22 | 1.24 |
| *2) Metallized Dyes* | *1.5%* | *0.5%* | *1.5%* | *1.5%/0.5%* |
| Palatine Fast Pink BNA High Conc | 0.4 R | 31.47 | 35.30 | 1.12 |
| Palatine Fast Red RNA-CF | 7.3 R | 26.54 | 33.26 | 1.25 |
| Palatine Fast Orange GNA-CF | 1.7 YR | 24.75 | 29.94 | 1.26 |
| Palatine Fast Orange GENA-CF | 3.0 YR | 23.68 | 29.27 | 1.24 |
| Palatine Fast Yellow ELNA-CF | 3.3 Y | 21.33 | 26.72 | 1.25 |
| Palatine Fast Yellow GGEN Conc CF | 7.0 Y | 18.60 | 24.15 | 1.30 |
| Palatine Fast Blue GGNA-CF | 8.2 B | 26.50 | 31.54 | 1.19 |
| Palatine Fast Blue RRNA-CF | 3.7 PB | 23.95 | 30.35 | 1.27 |
| Palatine Fast Violet 3RNA-CF | 2.2 P | 24.26 | 30.08 | 1.24 |
| Palatine Fast Violet 5RNA-CF | 1.8 RP | 25.05 | 31.16 | 1.24 |
| Palatine Fast Claret BNA-CF | 6.5 RP | 25.37 | 31.38 | 1.24 |
| Palatine Fast Claret RNA Conc CF | 10.0 RP | 29.43 | 34.67 | 1.18 |
| *3) Direct Cotton Dyes* | *2%* | *0.5%* | *2%* | *2%/0.5%* |
| Chloramine Red 8BSD-CF | 1.8 R | 29.06 | 33.93 | 1.17 |
| Diamine Scarlet 3BA-CF | 2.5 R | 29.81 | 33.41 | 1.12 |
| Fastusol Red L4BL | 3.2 R | 28.39 | 33.04 | 1.16 |
| Diamine Scarlet BA-CF | 5.0 R | 30.14 | 31.83 | 1.06 |
| Direct Fast Orange MR Conc | 4.8 YR | 22.98 | 28.71 | 1.25 |
| Stilbene Yellow TP Conc | 8.5 YR | 23.85 | 27.90 | 1.17 |
| Chrysophenine YA Supra Conc CF | 9.7 YR | 25.58 | 29.50 | 1.15 |
| Benzo Fast Yellow GN Conc | 0.8 Y | 23.59 | 29.84 | 1.26 |
| Fastusol Yellow LRRTD Ext Conc CF | 1.5 Y | 19.48 | 24.11 | 1.24 |
| Fastusol Yellow LRTP Ext Conc CF | 1.5 Y | 20.27 | 24.94 | 1.23 |
| Fastusol Yellow RA Ext | 1.5 Y | 22.35 | 28.73 | 1.29 |
| Fastusol Yellow LRRA Conc | 2.0 Y | 20.51 | 25.62 | 1.25 |
| Fastusol Yellow GA Ext | 4.8 Y | 21.99 | 25.58 | 1.16 |
| Fastusol Yellow GGA-CF | 5.8 Y | 22.45 | 25.02 | 1.11 |
| Fastusol Yellow L5GA | 1.0 GY | 18.33 | 19.93 | 1.09 |
| Brilliant Sky Blue 8GA Ext CF | 0.8 PB | 22.68 | 25.10 | 1.11 |
| Brilliant Benzo Blue 6BA Ext Conc | 4.2 PB | 23.18 | 28.32 | 1.22 |
| Brilliant Benzo Blue 6BI High Conc | 5.0 PB | 24.60 | 29.16 | 1.19 |
| Brilliant Sky Blue RRMA-CF | 6.8 PB | 23.21 | 25.53 | 1.10 |
| Fastusol Violet LF3BL | 9.5 PB | 19.85 | 25.39 | 1.28 |
| Phenamine Violet BA Conc CF | 0.9 P | 23.64 | 28.38 | 1.20 |
| Brilliant Benzo Violet BA-CF | 2.0 P | 24.76 | 28.91 | 1.17 |
| Fastusol Violet BBA-CF | 2.8 P | 25.02 | 29.68 | 1.19 |
| Fastusol Violet LBL Conc New | 3.4 P | 23.00 | 28.57 | 1.24 |
| Brilliant Benzo Violet RD | 5.0 P | 25.33 | 29.66 | 1.17 |
| Fastusol Violet LFRL | 5.7 P | 23.66 | 28.99 | 1.23 |
| Benzo Fast Heliotrope RRLA-CF | 9.4 P | 24.34 | 30.38 | 1.25 |
| Fastusol Red Violet LB | 0.8 RP | 21.59 | 28.50 | 1.32 |
| Fastusol Rubine LBBN | 4.4 RP | 23.48 | 29.15 | 1.24 |
| Benzo Rhoduline 3BA Conc CF | 5.0 RP | 30.28 | 31.48 | 1.04 |
| Benzo Rhoduline Red BA Conc CF | 9.5 RP | 27.03 | 32.40 | 1.20 |
| *4) Vat Dyes (Padded on Cotton)* | *40 g/l* | *16 g/l* | *40 g/l* | *40/16 g/l* |
| Indanthrene Red RK Double Pst | 4.0 R | 23.83 | 29.91 | 1.26 |
| Indanthrene Red 5RWP Pdr | 6.0 R | 24.23 | 30.02 | 1.24 |
| Indanthrene Black Brown VWP Pdr | 8.0 R | 21.52 | 27.64 | 1.28 |
| Indanthrene Orange RKWP Pdr | 9.4 R | 23.07 | 28.42 | 1.23 |
| Indanthrene Yellow GWP Pdr | 1.0 YR | 21.58 | 24.09 | 1.12 |
| Indanthrene Brown BRWP Pdr | 2.0 YR | 23.27 | 27.75 | 1.19 |
| Indanthrene Orange 2RTWP Pdr | 2.2 YR | 26.06 | 31.30 | 1.20 |
| Indanthrene Brown 2FRWP Pdr | 3.2 YR | 22.08 | 28.36 | 1.28 |
| Indanthrene Golden Orange GWP Pdr | 6.4 YR | 24.33 | 29.05 | 1.19 |
| Indanthrene Yellow 3RDWP Pdr | 8.0 YR | 23.72 | 27.94 | 1.18 |
| Indanthrene Brilliant Yellow 3GWP Pdr | 2.1 Y | 20.13 | 26.11 | 1.30 |
| Indanthrene Golden Yellow GK Pst | 2.1 Y | 18.51 | 23.84 | 1.29 |
| Indanthrene Khaki 2GWP Pdr | 5.0 Y | 20.85 | 29.61 | 1.42 |
| Indanthrene Olive RWP Pdr | 7.5 Y | 19.90 | 25.21 | 1.27 |
| Indanthrene Olive Green BWP Pdr | 4.0 G | 20.54 | 25.09 | 1.22 |
| Indanthrene Brilliant Green 4GWP Pdr | 5.9 G | 20.67 | 25.47 | 1.23 |
| Indanthrene Green GWP Pdr | 2.7 BG | 21.97 | 28.31 | 1.29 |
| Indanthrene Brilliant Green BNWP Pdr | 6.0 BG | 22.65 | 27.83 | 1.23 |
| Indanthrene Navy Blue GNWP Pdr | 5.0 PB | 27.00 | 31.24 | 1.16 |
| Indanthrene Dark Blue BODWP Pdr | 8.2 PB | 28.35 | 32.91 | 1.16 |
| Indanthrene Brilliant Violet 5BWP Pdr | 0.3 P | 27.63 | 31.83 | 1.15 |
| Indanthrene Brilliant Violet RRWP Pdr | 3.0 P | 28.03 | 33.34 | 1.19 |
| Indanthrene Brilliant Pink RWP Pdr | 9.2 RP | 20.90 | 28.17 | 1.35 |
| Indanthrene Red F2BWP Pdr | 9.8 RP | 25.02 | 29.04 | 1.16 |
| *5) Cellulose Acetate Dyes* | *1.5%* | *0.25%* | *1.5%* | *1.5%/0.25%* |
| Celliton Fast Red BBN | 6.0 R | 25.23 | 33.87 | 1.34 |
| Celliton Fast Red GGA Ext Conc | 7.5 R | 28.33 | 37.36 | 1.32 |
| Celliton Scarlet BA Ext | 7.5 R | 30.62 | 38.45 | 1.26 |
| Celliton Fast Scarlet RN | 9.6 R | 22.98 | 35.23 | 1.53 |
| Celliton Orange 3R | 9.6 R | 27.20 | 36.41 | 1.34 |
| Celliton Orange GRA | 2.9 YR | 26.62 | 35.15 | 1.32 |
| Celliton Fast Yellow 4RL Conc | 8.6 YR | 20.73 | 30.24 | 1.46 |
| Celliton Fast Yellow GA | 4.7 Y | 18.11 | 28.22 | 1.56 |

TABLE V

CONVERSION OF RATIO OF APPARENT STRENGTHS TO RATIO OF CONCENTRATIONS POWERS TO WHICH THE FORMER RATIO MUST BE RAISED TO YIELD THE SECOND

| Dye Class | Concentrations Lighter | Concentrations Heavier | Ratio of concentrations | Apparent Strengths Lighter $A_L$ | Apparent Strengths Heavier $A_H$ | Ratio $A_L/A_H$ | Power P |
|---|---|---|---|---|---|---|---|
| acid on wool | 0.5% | 2.0% | 4 | 27.90 | 33.70 | 1.21 | 7.1 |
| metallized acid | 0.5 | 1.5 | 3 | 24.99 | 30.65 | 1.23 | 5.3 |
| direct cotton | 0.5 | 2.0 | 4 | 24.01 | 28.44 | 1.19 | 8.0 |
| cellulose acetate | 0.25 | 1.5 | 6 | 24.99 | 34.37 | 1.39* | 5.4* |
| vat paddings | 16 g/l | 40 g/l | 2.5 | 23.16 | 28.44 | 1.23 | 4.4 |

* Data based upon only 8 cases.

for acid and direct-cotton dyes. For our purposes here we will assume that the ratio of strengths of dyeings (dyebath strengths) is equal to the ratio of concentrations on the fiber. In Table IV, parts 1 and 2, values of A are given for a 4:1 concentration change. It turns out, as seen in the summarizing Table V, that for acid wool dyes the average ratio of $A_{2\%}$:$A_{0.5\%}$ for the two concentrations is 1:21, which, raised to approximately the 7th power, yields the average ratio (4:1) of concentration. The corresponding data for the direct cotton dyes examined are nearly the same (1.19 raised to about the power 8 to yield concentration ratio 4), although the average apparent strengths of cotton dyes at the two concentrations are appreciably lower than those of the acid dyes.

The ratios of the A's for sample and standard can of course be converted to a ratio of concentrations readily enough by multiplying the logarithm of the ratio of A's by the powers listed as average for the proper dye class in Table V, then taking antilogarithms of the product. However, Table VI gives, for four classes of dyes, the result of this operation already solved for a number of relative A's between which others can be interpolated. This table is of course based upon averages for the dyes listed in Table IV; for particular dyes it will therefore contain errors. However, it is to be remembered that equations 1 and 2 are intended to be applied only when the ratio of A's for sample and standard is near unity, so that the error due to departure of an individual dye from the average of its class is small. Whenever the ratio of A's is moderately large or when greater accuracy is desired, the power p should be determined for the individual dye by determining the ratio of A's for a known ratio of concentrations, preferably those near the corresponding ones of Table V.

For the concentration change chosen, the average deviation from the mean of the ratio of apparent strengths tabulated is only 3.6% for acid dyes and 4.7% for direct cotton dyes.

TABLE VI

CONVERSION OF APPARENT STRENGTHS TO APPARENT CONCENTRATIONS

| Ratio of Apparent Strengths $R = A_H/A_L$* | Ratio of Apparent Concentrations: Acid Dyes $R^{7.12}$ | Metallized Dyes $R^{5.37}$ | Direct Cotton Dyes $R^{8.01}$ | Vat-Dye Paddings $R^{4.37}$ |
|---|---|---|---|---|
| 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 1.002 | 1.014 | 1.011 | 1.016 | 1.009 |
| 1.004 | 1.029 | 1.021 | 1.032 | 1.018 |
| 1.006 | 1.044 | 1.032 | 1.049 | 1.026 |
| 1.008 | 1.058 | 1.043 | 1.066 | 1.035 |
| 1.010 | 1.073 | 1.054 | 1.083 | 1.044 |
| 1.012 | 1.089 | 1.065 | 1.100 | 1.053 |
| 1.014 | 1.104 | 1.076 | 1.118 | 1.063 |
| 1.016 | 1.120 | 1.087 | 1.136 | 1.072 |
| 1.018 | 1.135 | 1.099 | 1.154 | 1.081 |
| 1.020 | 1.151 | 1.110 | 1.172 | 1.090 |
| 1.022 | 1.168 | 1.122 | 1.190 | 1.100 |
| 1.024 | 1.184 | 1.133 | 1.209 | 1.109 |
| 1.026 | 1.201 | 1.145 | 1.228 | 1.119 |
| 1.028 | 1.217 | 1.157 | 1.248 | 1.128 |
| 1.030 | 1.234 | 1.169 | 1.267 | 1.138 |
| 1.032 | 1.251 | 1.181 | 1.287 | 1.147 |
| 1.034 | 1.269 | 1.193 | 1.307 | 1.157 |
| 1.036 | 1.286 | 1.205 | 1.327 | 1.167 |
| 1.038 | 1.304 | 1.217 | 1.348 | 1.177 |
| 1.040 | 1.322 | 1.230 | 1.369 | 1.187 |
| 1.042 | 1.340 | 1.242 | — | 1.197 |
| 1.044 | 1.359 | 1.255 | — | 1.207 |
| 1.046 | — | 1.267 | — | 1.217 |
| 1.048 | — | 1.280 | — | 1.227 |
| 1.050 | — | 1.293 | — | 1.238 |

* Ratio of apparent strengths (depths) of heavier dyeing to depth of lighter dyeing, *heavier* and *lighter* having the meanings given in Table V.

EXAMPLES OF THE METHOD——

(1) The following two dyeings were both rough trial matches to a particular standard. They were measured in the General Electric Recording Spectrophotometer equipped with the GAF-Librascope Tristimulus Integrator, which obtained automatically the tristimulus values X, Y, and Z; and from these (reduced to percentages of their total) Munsell hue (H), value (V) and chroma (C) were obtained by means of enlarged graphs of the Munsell Renotation colors *(5)*. The dyeings were (figures based on weight of wool) as follows:

| | No. 1 % | No. 2 % |
|---|---|---|
| Scarlet 4RA Conc | 1.82 | 1.9 |
| Alizarine Rubinol 3G | — | 0.1 |
| Carmoisine BA | 0.096 | — |
| Total | 1.916 | 2.0 |
| *Color Analyses* | | |
| X | .2030 | .2179 |
| Y | .1066 | .1155 |
| Z | .0305 | .0338 |
| $x = X/(X + Y + Z)$ | .5969 | .5934 |
| $y = Y/(X + Y + Z)$ | .3134 | .3145 |
| H | 6.5 R | 7.0 R |
| V | 3.79 | 3.93 |
| C | 14.0 | 14.2 |
| A (computed) | 38.14 | 37.70 |

Equations 1 and 2 were applied to these data, yielding

Apparent strength, No. 1: $A_1 = 28.86 + 9.28 = 38.14$

Apparent strength, No. 2: $A_2 = 28.12 + 9.58 = 37.70$

Ratio: $A_1/A_2 = 38.14/37.70 = 1.0117$

From Table VI, the ratio of apparent concentrations is 1.087. This means that dyeing No. 1, which contains actually only 96% as much dye as No. 2, would be judged to have a concentration 8.7% greater. In fact, No. 1 *was* judged by one colorist in our laboratory as 5-10% stronger, and by another as 10% stronger, than No. 2. No. 1 is then the preferred way to shade the dyeing with Scarlet 4RA Concentrated. The reason for this result is connected with the greater darkness of the Carmoisine BA, used as a shading dye, as compared with the Alizarine Rubinol 3G when the two are at equivalent concentrations.

(2) In another example, two 3-component mixtures each with the same main constituent and about 4% total shading dye were compared by measurement and direct visual judgments. Although the dyeing of mixture No. 4 contained 14% less dye than that of No. 3, No. 4 was judged by various chemists and colorists to be from 5 to 20% stronger (average +12%). Measurement and application of equations 1 and 2 gave respective apparent strengths of 28.65 and 27.78, which correspond, according to Table VI, to an increase of apparent concentration of about 24% for No. 4 over No. 3. This last figure and the table is based upon the use of an average power (7.12) for all the acid dyes studied. If we use instead the power (5.94) actually found for the par-

ticular main-constituent dye, Alizarine Rubinol R, the increase of apparent strength is found to be about 20%, a better check of the visual judgments.

In this second example there is an appreciable shade (hue) and brightness difference present, and the shading is not of a practical nature, but the example goes to show that very large increases of apparent strength (depth) are at least possible (here 14 + 12 = 26%) by proper choice of even a small amount of shading dye.

The basic idea involved in these shadings to get the best possible apparent strength was stated in the section on *The Nature of Apparent Strength*. There it was said that apparent strength "is strictly a visual quantity which measures, as more and more dye is put on a 'white' fiber, how far the color departs from white in a 3-dimensional color space similar to that of the Munsell color system. The stronger the dyeing, the farther from the 'white' point is the point representing its color." When we shade a given color with an admixture, the question then is merely whether or not the color is farther from white, that is, whether the point representing the shaded color is farther from or nearer to the white point than the original color. If the shaded color is farther from white than the original color, it is stronger; if nearer to white, it is weaker. "White" is defined exactly below.

While we use a Munsell type of color space for which circular geometry fixes the relative magnitudes of the hue and chroma[3] steps or units, it is found best experimentally to use a color space in which one Munsell value step is equivalent visually to 4 chroma steps. This is indicated in equation 1 (the constant 16 here is the square of 4).

Since formulas 1 and 2 are most useful when visual estimates are difficult, that is, when a hue difference is present, in general the hue correction of equation 2 will be applied. This requires mere reference to Table I, perhaps with interpolation to the nearest 0.1 Munsell hue step, and then a simple slide-rule multiplication of the figure of the last column by the chroma. This resulting correction factor is merely added to the uncorrected result of the calculation from equation 1. Since in general we are considering two alternative ways of shading a given color to a desired color, or comparing two competitive dyes of similar hue, the correction factors will be nearly the same for the two colors. In general the best shading color (from the standpoint of strength only) will be nearer black than the given color at the requisite concentration, or at least very dark and

[3] Dyer's "brightness" or dullness is closely related to, but not identical, with Munsell chroma. For two fairly similar colors, it is perhaps more exactly equivalent to the product of Munsell value and chroma.

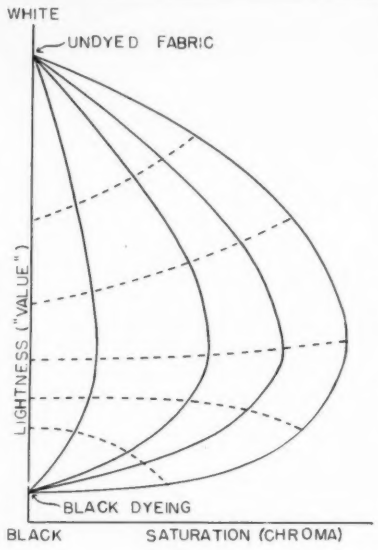



**Figure 1**

The solid lines are lines of constant dyer's brightness (increasing strength in going away from the white point). The dotted lines are lines of constant strength.

The figure is diagrammatic only. Yellows and oranges will have the bulge (maximum brightness) at a high "value," blues and purples at a low "value".

of as high chroma as can be obtained in a very dark color of the requisite hue. In gauging nearness to black, remember that one step of Munsell value is here equivalent to several steps of chroma.

In the general case of comparing competitive dyes for strength, of course, even if the colors are extremely similar at some concentrations, they may not be so at another concentration, and we need to have a way of measuring the comparative strengths.

IMPORTANT LIMITATION OF THE METHOD———Figure 1 is a slight modification of a diagram on page 291 of *Color in Business, Science and Industry*, by D B Judd of the National Bureau of Standards, international authority on color. Judd told the present writer that the diagram and the text leading up to it were derived very largely from past discussions between the two of us concerning the way brightness and strength (in relation to the color scientist's *lightness* and *saturation*, or *chroma*) change as increasing amounts of dye are put on the fiber. The solid lines are lines of constant dyer's brightness and the dotted lines are lines of constant strength. The diagram is schematic rather than exact. The constant brightness lines nearest the white-black axis are those of a dull dye, while the highly curved line at the extreme right is that of a bright dye. As increasing amounts of dye are added to the "white" (gray) goods, the brightness increases along with strength up to a maximum at a point where the lightness is usually somewhat below the middle line between white and black. The position of this point and the whole curve vary from dye to dye. For yellows and oranges the maximum is at high lightness, while for blues and purples it is at low lightness (dark colors).

Though the figure is diagramatic, it is sufficiently exact to show that relations true for the upper portion are not valid for the very dark colors of the lower portion. The depth formulas 1 and 2 were determined primarily for colors of the upper portion of the figure. They may not hold for very dark colors, or at least will there represent a poorer approximation to the facts.

GRAPHICAL SOLUTION OF EQUATION 1———The solution of equation 1 may be obtained with considerable ease in about 30 seconds after preparation of a simple plot and a calibrated straightedge. Millimeter cross-section paper 400 x 1000 mm is required. On the *long* left edge the Munsell value scale is marked off, with zero at the bottom and 10 at the top, 100 mm to each unit. At the top *short* edge the chroma scale is marked off from zero at the left to 16 at the right, 25 mm to each unit. A straightedge marked exactly like the top chroma scale is prepared, for example, by carefully glueing a strip of millimeter cross-section paper to a rigid brass or plastic slip. This rule should be 400 mm long or even longer. On this and the chroma scale, 1 mm = 0.04 units; on the Munsell value scale, 1 mm = 0.01 unit.

To determine depth or apparent strength (S, uncorrected), the zero mark on the straightedge is placed at the mark corresponding to the value (lightness or darkness) of the color. The straightedge is passed through the mark corresponding to the chroma of the color, and the straightedge scale is then read off to give the value of uncorrected S.

A simple slide-rule multiplication, after consultation of Table I, suffices to determine the hue correction, which is added to the uncorrected value of S.

THE "WHITE" POINT ——— Although wool, cotton and other woven cloths are quite yellowish or greenish (for example, wool: 2.5 Y 8.4/1.7; cotton: 7.5 BG 9.2/0.4; nylon: 5.0 Y 9.3/0.5), and the departure of the colors of very light dyeings starts from the color of the undyed fabric, it was found experimentally that in the useful range for strength comparisons the ideal white of Munsell value 10 and chroma zero yielded better results than the actual color of undyed cloth in computing and comparing ap-

*(concluded on page P696)*

*Piedmont Section—*

# THE PIGMENT BINDING POWER OF TEXTILE FINISHING MATERIALS*

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In order to study the effect of resin binders on the pigment binding power of textile finishes, it was first necessary to establish a quantitative method of evaluation. The quantitative loss-on-tearing method herein described was found to answer this purpose.

Factors affecting the test method were studied by use of standard starch and filler compositions. It was determined that results in a given series were readily reproducible. The amount of dusting was found to depend principally on

a) Type of binders
b) Type of fabric
c) Type of pigment and ratio to binder
d) Softeners and modifiers added to the binder.

It was determined that there is no definite ratio at which the binder binds *all* the pigment to the fabric, but that some dusting out occurs even at very low pigment-to-binder ratios. It was further established that dusting out is not selective, but that the "dust" contains *binder* and *pigment* in the same ratio originally present on the fabric. Thus, dusting must occur through decrease of adhesion and cohesion of the binder film on pigment loading.

The effect of various types of starch additives has been studied. Polyvinyl acetate emulsions yield marked increases in binding power, and moderate additions to starch permit great increases in pigmentation with no increase in tearing loss.

## INTRODUCTION

HEAVY starch and resin finishes are frequently applied to one or both sides of a textile fabric to produce back-filled and stiffened fabrics, buckrams, hollands, bookcloth, tracing cloth, or shade cloth. In many cases mineral fillers or pigments are incorporated in the mixture as inert extenders to increase bulk and weight, to improve the surface finish, to reduce cost, or to impart tinting or hiding power.

The cohesion of the starch or resin film, its adhesion to the fabric, and its ability to hold tightly to the pigment embedded in it are factors of very great importance in this type of finishing. It is a bit disconcerting to find that there is still some tendency to refer to all materials added to coating mixtures as "binders," even though they are actually added as softeners or lubricants. For the purpose of this presentation, a *binder* is defined as any film-forming material which coats the particles of pigment or filler and adheres to the fabric, thereby preventing ready removal of pigment from the coated or impregnated fabric. By the same token, any added material which improves the binding power of a film-forming mixture would be either a binder in itself, or would in some manner enhance the adhesion or cohesion of the original material. *Pigment binding power* is the ability of any given film-forming composition to hold pigments and fillers in such a manner as to prevent *dusting out* from the film or fabric on flexing or tearing.

The measurement of binding power has been studied in the past by several methods:

A) A quantitative method whereby the coated material is subjected to a continuous flexing action, causing loosely bound pigment to dust out *(1)*. In these early investigations, unmodified, unplasticized starches showed the greatest binding power and cohesiveness, while modified starches or starches containing plasticizers (sulfated or unsulfated fats and oils, glycerine, glycols) were definitely inferior.

B) The "pick" method *(2, 3)*, in which the coating is tested with waxes of varying melting points or degrees of adhesiveness to determine the force necessary to disrupt the film or to separate it from the base. This method has been used in paper coatings to study the effect of pigments and fillers on adhesion and cohesion, and to determine the surface strength of paper. For coated papers or fabrics, it can be employed only on sizings that adhere well to waxes.

C) Tearing tests, in which dusting out of the filler and binder on tearing the fabric is measured. This has been applied in the past by tearing fabrics over a black material and comparing qualitatively the amount of dusting out for various samples.

## I. A QUANTITATIVE TEARING-LOSS TEST

The procedure used in this investigation is a refinement of the tearing test, in which, instead of observing the amount of dusting visually, the actual loss in weight is determined per unit length of tear. In order to obtain results comparable with past methods, the test procedure was standardized with starch coatings, although later investigations include resin binders.

In evaluating starch mixtures, the starch (together with pigments, softeners, binders, etc) was mixed with water and heated to 185°F (85°C) with stirring. After being heated at 185-194°F (85-90°C) for five minutes, the mixture was applied to a 4x12-inch strip of bleached 64x60 cotton cloth on a laboratory padder with just enough pressure to grip the cloth firmly. The fabric was dried over a steam cylinder, then coated again on the back, and dried under warpwise tension. The coated swatch was then calendered without friction and allowed to reach equilibrium room condition before testing. Where standard-temperature and -humidity equipment is not available, the tests are run in sets, in which swatches to be compared with each other are conditioned and tested together.

The finished swatch was trimmed to a 26-cm length, and four 1-cm cuts were made warpwise in one end of the test swatch. The fabric was then weighed on the analytical balance and torn warpwise at each cut at an approximately constant rate of about 25 cm/sec to avoid variations in amount of dusting because of variations in applied energy. The strips of torn fabric were weighed again, and the loss in weight recorded as *milligrams loss per meter*. If less than 100 centimeters has actually been torn, the weight loss is multiplied by the appropriate factor to obtain *milligrams per meter*. Handling and tearing of the fabrics are accomplished with tweezers, folded strips of paper or cotton gloves being used to prevent moisture of the hands from affecting the weight.

In a preliminary set of tests to illustrate the reproducibility of results and range of values obtained, black pigmented starch mixtures containing various softeners were padded on a 96x25, 7.5-ounce, dyed, cotton base cloth as described above. Two tests of 25-cm tearing lengths were run on each fabric, and the results were compared with a similar commercial lot of black buckram bookcloth, a lighter embossed bookcloth,

* Presented before the Piedmont Section on Jan 30, 1954. Edited ms submitted July 26, 1954.

**TABLE I**
**BOOKCLOTH SAMPLES**

| *Laboratory Samples* | *Count* | *Weight grams* | *Base Fabric Weight oz/sq yd* | *Loss per Meter milligrams* 1 | 2 | *Softener* |
|---|---|---|---|---|---|---|
| Black Buckram | 96x25 | 10.9 | 7.5 | 126 | 122 | 75% sulf tallow |
| | | | | 87 | 71 | 75% sulf castor |
| | | | | 40 | 40 | sulfated ester |
| | | | | 35 | 35 | glycerine |
| *Commercial Samples* | | | | | | |
| Black Buckram | 96x25 | 11.0 | 7.5 | 115 | 106 | 75% sulf tallow |
| Black Embossed | 48x39 | 3.6 | 1.7 | 115 | 110 | |
| Pyroxylin Coated | 62x55 | 5.9 | 3.6 | 2 | 0 | |

**TABLE II**
**EFFECT OF COATING WEIGHT**
**(Starch 25 + Talc 100 + Water 200 + Sulf Castor 1.5 g)**

| | *A. All cooked together* | | | *B. Oil added after cooking* | | |
|---|---|---|---|---|---|---|
| a) No. of runs each side | *1* | *2* | *3* | *1* | *2* | *3* |
| b) Coating, oz/yd² | 3.15 | 4.77 | 6.35 | 3.14 | 4.83 | 6.23 |
| c) Starch, oz/yd² | 0.63 | 0.95 | 1.27 | 0.63 | 0.97 | 1.25 |
| d) Loss, mg/m | 85 | 119 | 165 | 82 | 110 | 144 |
| e) Loss, mg/m per oz/yd² coatg | 27 | 25 | 26 | 26 | 23 | 23 |
| f) Loss, mg/m per oz/yd² starch | 135 | 125 | 130 | 130 | 113 | 115 |

**TABLE III**

| Ratio Talc: Starch (wheat) | *0:1* | *1:1* | *2:1* | *3:1* | *4:1* | *6:1* |
|---|---|---|---|---|---|---|
| mg loss/m/oz/yd² starch | 0.28 | 23.5 | 42 | 60 | 100 | 250 |
| % Talc in solids | | 50 | 66 | 74 | 79 | 85 |
| % Ash in dust | | 51.8 | 65.2 | 70 | 77 | 81.5 |

and a pyroxylin-coated fabric (see Table I).

Duplicate tests checked quite closely, and a laboratory sample checked well with a commercial sample of similar specifications. This test also indicates the great effect of type and quantity of softener on binding power. This effect was investigated in greater detail in subsequent test series. The order of dusting loss seemed to correlate with the degree of softness imparted to the film.

EFFECT OF WEIGHT OF COATING ———It would seem reasonable to assume that the greater the total coating weight on a fabric, the greater the amount of material which will dust out on tearing. If we are to evaluate the effect of binders, resins, starches, and softeners, it is necessary to correct the tearing loss to allow for experimental variations in total coating weight. In all the following tests this is accomplished by dividing by the weight of coating in ounces per square yard. The tearing-loss factor then becomes "milligrams per meter per ounce per square yard" (mg/m per oz/yd²). This mixed metric-English unit is adopted with due apology — in recognition of the fact that "oz/yd²" is much more widely used as a measure of unit fabric weight. To convert the "mg/m per oz/yd²" to the more scientific "mg/m per g/m²," it would only be necessary to divide by 33.8.

The effect of various conditions on the tearing-loss test method was investigated by employing a coating of wheat starch, water, softener, clay, or talc (several times the quantity generally used commercially, to amplify the dusting-out effect). The cloth employed was a bleached 75x55 cotton fabric weighing 2.50 oz/yd². Square-yard weights of the coated fabrics were obtained by punching out 2.138-inch squares, weighing in grams, and moving the decimal one place to the right *(4)*. The coating weight is obtained by subtracting the *base weight* (bleached weight times finished count divided by bleached count) from the finished-weight.

The loss in milligrams is approximately proportional to the weight of coating, and values in rows "e" (loss for 1 oz/yd² coating) and "f" (loss for 1 oz/yd² starch) are nearly constant, regardless of the amount of material on the surface. Apparently, it makes very little difference whether the plasticizer is added before or after the starch is cooked.

In Table II it is evident that it makes little difference whether we compare the figures for dusting for *1 oz/yd² of total coating* or *1 oz/yd² of starch*. In subsequent tests for comparing various *starches* with each other, dusting out per ounce/sq yd of *starch* (uncorrected for moisture content) was chosen. This is readily calculated by multiplying the coating weight by the ratio of starch to total solids.

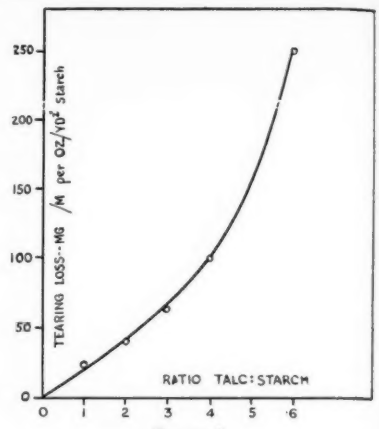


**Figure 1**

**Effect of pigment/binder ratio on tearing loss**

MECHANISM OF DUSTING OUT ON TEARING———In evaluating the binding power of starch (or other film-forming materials) it would be very convenient if we could assume that one part of starch binds *n* parts of pigment, and that, on tearing or subjecting to mechanical action a film containing more than *n* parts of pigment, the excess of pigment would dust out until only *n* parts remain. If this were even approximately true, we should find the amount of pigment in the "dust" to increase considerably as the ratio of pigment to starch increases. In the following series of tests, 25 g wheat starch and 1 g sulfated tallow where cooked in the presence of varying amounts of talc. The mixture was applied, two runs on each side with intermediate drying, on the 2.50-oz/yd² cloth described above. The fabrics were torn, the loss in weight was determined, and the dust was collected and ashed.

Thus, the material which dusts out of the fabric has approximately the same composition as the coating which remains on the fabric, and the pigment is not preferentially removed. Variations in dusting out of coating compositions must be due entirely to modification in cohesion of the binder film and its adhesion to the fabric by the pigments and other materials added.

The graph of Fig 1 shows that the binding power of starch cannot be expressed as the quantity of pigment which can be retained by a given amount of starch, since a certain amount of dusting out takes place even with small amounts of pigment.

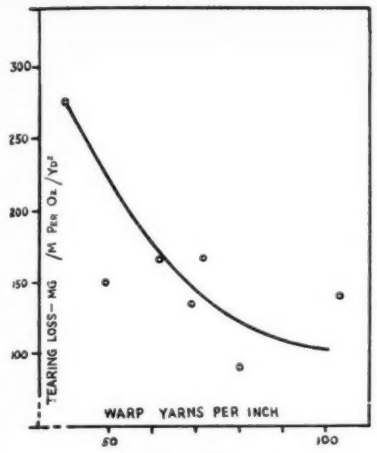


**Figure 2**
**Effect of thread count (yarns per inch)**

EFFECT OF TYPE OF BASE CLOTH———The same starch formulation was applied twice on each side of a variety of bleached fabrics. The fabrics were calendered twice, conditioned and tested.

Since the fabrics were torn warpwise, it would be expected that the warp count would have the greatest effect on the amount of dusting out. The wider the strip of starch film between two adjacent warp yarns, the more dusting out we may expect. The number of filling yarns per inch should have a secondary effect, and the base weight of the fabric should have the least influence. Reference to Table IV shows that there is little correlation with base weight or filling count, and that the greatest correlation is with warp count (Fig 2).

EFFECT OF CALENDERING———A wheat-starch mixture containing 25 g starch plus 50 g talc plus 2 g sulfated tallow was cooked with 200 ml water to 194°F (90°C). Two runs were applied on each side of the standard cloth. The samples were calendered as described in Table V and tested for loss on tearing.

In the uncalendered fabric, the coating mixture builds up most heavily around the yarns, and the interstices between the yarns are not completely filled, hence, there is less dusting out on tearing. The effect of calendering lightly is to spread the coating out, partially to fill in the interstices, and thus to leave more coating material accessible for dusting. With frictioning or increased pressure, the film and fabric are apparently consolidated better, and adhesion and cohesion are improved, so that dusting is only slightly more than with uncalendered samples. Thus, the importance of uniform calendering procedure is evident.

**TABLE IV**

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| Finished Count | 48x45 | 70x55 | 68x55 | 80x73 | 62x55 | 39x29 | 104x91 |
| Bleached weight oz/yd² | 1.82 | 2.85 | 2.97 | 3.18 | 3.64 | 4.73 | 2.81 |
| mg loss/m/per oz/yd² starch | 151 | 160 | 141 | 92 | 164 | 277 | 140 |

**TABLE V**

| | *Tearing Loss* |
|---|---|
| Uncalendered: | 43 mg/m per oz/yd² starch |
| Calendered (once each side): | |
| No Friction: | 75 |
| Friction: | 59 |
| High hydraulic pressure | 54 (no friction) |

**TABLE VI**
**TEARING-TEST RESULTS**
**Mgms/m per oz/yd² Starch**

| Pigment: Starch Ratio | *0* | *0.25* | *0.50* | *1.0* | *2.0* | *3.0* | *4.0* | *6.0* |
|---|---|---|---|---|---|---|---|---|
| Clay | 0.3 | — | 0.9 | 2.9 | 9.4 | 25. | 48 | 134 |
| Talc | — | — | 3.3 | 4.0 | 11.8 | 26.3 | 50 | 109 |
| Barytes A | — | — | 3.8 | 9.3 | 12.8 | 26. | 45 | 141 |
| Mg Carbonate pptd | — | 3.0 | 9.1 | 25.6 | 140. | — | — | — |
| Titanox C | — | — | — | 6.4 | 13.4 | 30.4 | 38 | 167 |

CONCLUSIONS———A method has been described for the quantitative measurement of the pigment binding power of coating materials by the loss-on-tearing test. Variations in coating weight are compensated by calculating the milligrams/meter loss and adjusting to the basis of 1 oz/sq yd of coating or of binder.

As material which dusts out has virtually the same composition as that which remains on the cloth, there is very little tendency toward selective dusting out of the pigment even for very high pigment-to-starch ratios. Thus, increasing amounts of pigment must weaken the cohesive forces holding the film together and the adhesive force binding the coating to the fabric.

The importance of standardizing the type of cloth, application and calendering procedure, and testing conditions are pointed out. The use of standard humidity-temperature conditioning and tearing with a constant-rate tensile tester would be advisable for accurate work, but even without these refinements, interesting and reproducible results have been obtained.

## II. EFFECT OF BINDERS, STARCHES, RESINS, SOFTENERS, AND PIGMENTS

EFFECT OF TYPE OF PIGMENT AND RATIO TO BINDER———By use of the test method outlined in the preceding section, a series of swatches were prepared with various ratios of five different pigments and fillers in conjunction with wheat starch. The base fabric was a bleached 64x60 cotton muslin. The starch composition contained 25 grams wheat starch, and 160 ml water, and the required amount of pigment to give ratios of 0.25 to 6.0 times the weight of starch at room conditions. No plasticizer was employed in these tests. For ratios above 3:1, more water was added to obtain a satisfactory coating consistency. The mixture was cooked at 185°F (85°C) for five minutes and then was coated twice on each side of the fabric. The material was dried between coats on a steam cylinder.

The data of Table VI are plotted in Fig 3, and it is interesting to note that the curves for Titanox, clay, and talc run very close together — almost within the range of experimental error — but the curves for the very light and very heavy pigments, magnesium carbonate and barytes, are widely spaced at the two ends of the graph. If the spread is due entirely to the specific gravity of the pigments, then recalculation of the pigment:starch ratio to a volume basis, and of the tearing loss to a volume basis should bring all the curves reasonably close together. In Fig 4 these calculations have been performed by adjusting the weight ratio for specific gravity of the pigments against a specific gravity of 1.5 for starch and by dividing the tearing loss by a weighted-average specific gravity for starch plus pigment. While the curves for Fig 4 have

TABLE VII
CHARACTERISTICS OF PIGMENTS

| | Specific Gravity | Water Absorption Pigment 10 g ml | 10 ml ml |
|---|---|---|---|
| China Clay | 2.60 | 5.8 | 15.1 |
| Talc | 2.77 | 5.7 | 15.8 |
| Barytes | 4.45 | 1.6 | 7.2 |
| $MgCO_3$ | 2.22 | 34.5 | 75.7 |
| (Starch | 1.5) | | |
| Titanox C | 3.14 | 5.0 | 15.7 |

moved slightly closer together, there is still too much spread in the light and heavy pigments to allow an explanation based entirely on specific gravity. It is likely that the residual difference between these pigments is due principally to the specific surface of the particles and to factors affecting adhesion of the starch film to the pigment particles. Table VII shows the specific gravity of the pigments (as listed in Gardner's Handbook) and the water absorption (ml of water required to wet out 10 grams of pigment). In the last column, the water absorption is calculated to a pigment-volume basis, and these factors are listed on the graphs of Fig 4 (in parentheses) for comparison.

The effect of fillers on performance in friction calendering is interesting. It was found that swatches prepared with a 2:1 ratio of clay or talc to starch "grabbed" on the calendar and were badly chewed up. Blanc fixe, or barytes, could be friction-calendered with no difficulty whatever.

EFFECT OF COOKING TEMPERATURE OF STARCHES———As might be expected, the film-forming properties, film strength, and pigment binding power of starches are greatly improved by cooking at a temperature high enough to burst all the starch granules. In warp-sizing operations, starches are generally heated at the boil for a long time, and the temperature is kept quite high during application. In backslashing with heavy starch mixtures containing pigments or fillers, the batch is often cooked to about 185° (85°C) until maximum thickening is obtained. At this temperature the starch granules are swelled greatly, but very few of them burst. More thorough cooking would certainly be advantageous but is often avoided because the starch might then tend to skin over more readily on cooling and to set to a rubbery unworkable gel in the box of the mangle or backfilling machine.

To determine the effect of cooking on binding power, 25 g of wheat starch was dispersed in 200 ml of water, and the required amount of talc and softener was added. The mixture was applied to the fabric, and tests were conducted as previously described. The results are given in Table VIII.

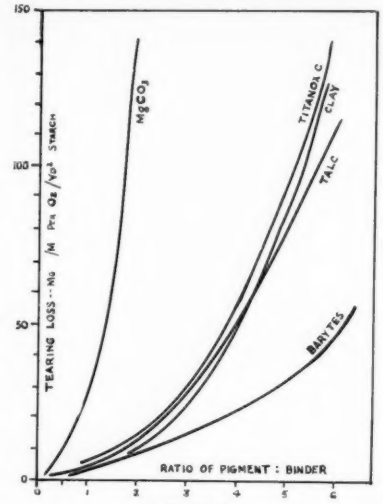


Figure 3
Effect of type of pigment at various pigment/binder weight ratios

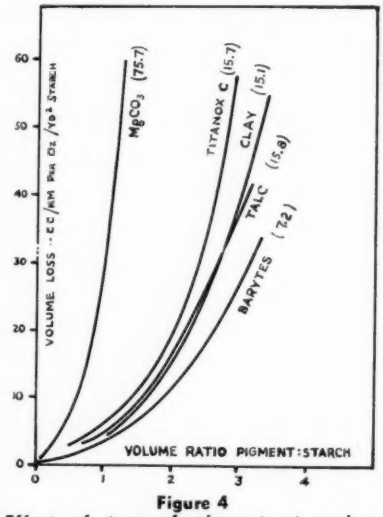


Figure 4
Effect of type of pigment at various volume ratios

(Parenthetical figures represent water-absorption values)

At 149°F (65°C) the starch showed incipient swelling, and the resulting paste showed a considerable amount of syneresis. At 167° (75°C) the syneresis was slight; at 185°F (85°C) very slight, and at 203°F (95°C) no syneresis was noted. The improvement in binding power with cooking temperature is very definite, as illustrated in Fig 5. The increase in tearing loss with addition of softeners, especially sulfated oil, is notable.

TABLE IX
EFFECT OF AMOUNT OF SULFATED TALLOW ON TEARING LOSS

mgms/m per oz/yd² starch
Talc: Starch Ratio

| Sulfated Tallow | 1 | 2 | 3 | 4 | 6 |
|---|---|---|---|---|---|
| 1 g | 24 | 42 | 62 | 100 | 250 |
| 2 g | 31 | 75 | 106 | 178 | 267 |
| 4 g | 47 | 76 | 140 | 202 | 372 |

EFFECT OF QUANTITY OF SOFTENER USED———In mixtures containing 25 g wheat starch in 200 ml water with varying amounts of talc, various amounts of sulfated tallow were added. The mixtures were applied to cloth and tested.

The very definite increase in tearing-loss with increasing amount of sulfated tallow, shown in Table IX, is illustrated in the graph of Fig 6.

BINDING POWER OF VARIOUS STARCHES———In a series of tests with various types of starches, 25 g of starch and 100 g of talc were dispersed in 200 ml of water and cooked at 194°F (90°C). No plasticizer was employed. Swatches were coated, calendered, and tested with the following results given in Table X.

The order of pigment binding power of the starches in Table X appears to be fairly reproducible; however, it must be pointed out that these starches represent individual single shipments from one manufacturer each. It is quite possible that a series of samples obtained from other sources or at other seasons may result in a slightly different order of binding power.

The much poorer binding power of wheat flour is interesting, and is undoubtedly due to the lower binding power of the gluten content, particularly in the clear grades.

EFFECT OF MODIFIED STARCHES, CHEMICAL ADDITIONS, BINDERS———A standard batch containing 25 g wheat starch, 100 g talc, 200 ml water, and 2 g glycerine was cooked at 194°F

TABLE VIII
EFFECT OF COOKING TEMPERATURE ON BINDING POWER

mg/m per oz/yd², starch

| Talc/starch ratio | Softener | Cooking temp °F | 149 | 167 | 185 | 203 |
|---|---|---|---|---|---|---|
| | | °C | 65 | 75 | 85 | 95 |
| 4:1 | none | | 84 | 71 | 62 | 57 |
| 2:1 | none | | 21 | 16 | 12 | 11 |
| | sulf castor oil, 2 g | | 58 | 50 | 42 | 41 |
| | glycerine, 2.8 g | | 21 | 21 | 17 | 14 |

TABLE X

COMPARATIVE BINDING POWER OF STARCHES

| Starch | Tearing Loss in mg/m per oz/yd² starch | Check Test |
|---|---|---|
| Potato, Maine, powd | 46 | 50 |
| Wheat starch | 51 | 51 |
| Corn starch (Globe No. 3) | 55 | 52 |
| Tapioca (Imperial B-1) | 72 | 60 |
| Rice starch | 77 | 76 |
| Wheat flours (so't winter) | | |
| Straight SW | 118 | |
| Straight NW | 120 | |
| 1st clear | 137 | |
| 2nd clear | 158 | |

(90°C), coated on fabric, and tested. Other additions were made as noted in Table XI.

Thin-boiling starches have much less binding power than untreated starches, and other tests have shown that dextrines have very little binding power. Glucose, and to a smaller extent, urea, act as promotors of binding power; their use also results in smoother starch pastes, but the starch films are more sensitive to water.

Calcium chloride had little effect, but borax (as well as casein and karaya gum, which require alkaline dispersing agents) all caused a reduction in binding power, indicating that free alkalinity may cause reduction in the pigment binding power of starches.

The use of methyl cellulose resulted in a slight increase in binding power.

Methylolurea yielded the most surprising results. Replacement of a small amount of starch by methylolurea reduced the tearing losse to less than half its former value. The coating resisted removal by boiling water. The improvement on addition of thermoplastic resin emulsions is quite marked and is described in a later series of tests.

EFFECT OF VARIOUS TYPES OF SOFTENERS———Various types of softeners were compared in a test similar to that described above for effect on binding power. The results are presented in Table XII.

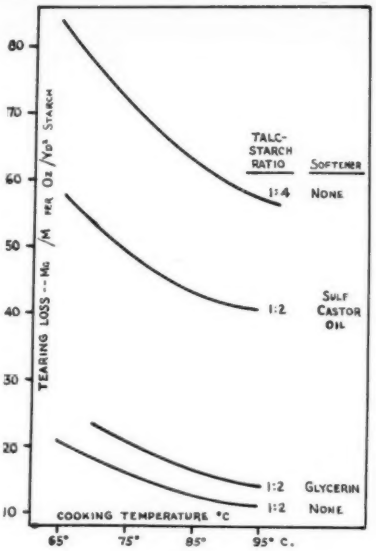


**Figure 5**

**Effect of starch-cooking temperatures at various pigment ratios and with various plasticizers**

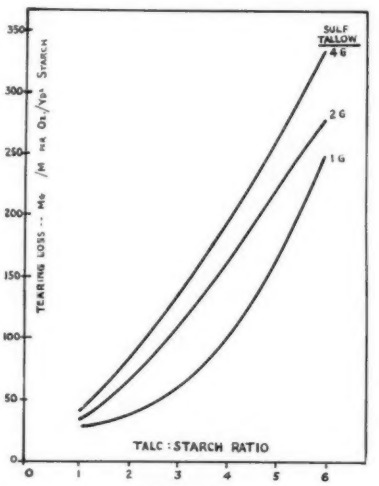


**Figure 6**

**Effect of plasticizer additions**

(75% sulfated tallow at various talc/starch ratios)

The relatively poor performance of soaps, sulfated oils and sulfated tallows is noteworthy in comparison with glycerine and tallow or stearic acid. Since there is no definite correlation between tearing loss and $SO_3$ content for softeners, it seems likely that the fatty-acid-soap components of the sulfated oils and tallows (which may amount to 30% or more of the fatty matter) are the offending ingredients. Diglycol laurate is also solubilized with a soap, which may account for its poor performance. The sulfated castor and soap-plasticized starches yielded films which showed poor continuity (when cast on glass), while unplasticized starches or those plasticized with glycerine and glycols are continuous. Continuous-film properties correlated quite well with binding-power measurements.

EMULSION-POLYMER BINDERS———The thermoplastic-resin-emsulion polymers have found increasing usage in textile finishing. Many types of polymers and copolymers are employed *(5)* for various purposes. Polyvinyl acetate emulsions are economical and are very widely used as pure finishes or in conjunction with starches or pigments to improve washfastness and pigment binding power. Polyvinyl acetate addition also increases the adhesion of finishes to synthetic fibers and increases the adhesion of subsequent pyroxylin, oleoresinous, or glue coatings to the fabric.

In heavily pigmented backfillings, replacing part of the starch by equal-money-value quantities of polyvinyl acetate emulsion results in a considerable increase in binding power. Fig 7 indicates the effect of successive additions of 55% nonionic polyvinyl acetate emulsion to a one-pound-per-gallon-wheat-flour paste containing 3 oz sulfated tallow and 3 oz clay per gallon. The improvement in pigment binding is marked, even for small additions of polyvinyl acetate.

Fig 8 shows the improvement in binding power, at various degrees of clay loading, resulting from successive additions of polyvinyl acetate. By the addition of 4 oz per gallon of 55% polyvinyl acetate emulsion, the amount of clay has been increased 60% without affecting the tearing loss.

CONCLUSION———The measurement of binding power by the loss-on-tearing technique has been applied to the evaluation of a number of factors which contribute to pigment binding power. The amount of pigment that can be effectively held in the binder film depends on the type of pigment, and factors of especial importance appear to be the density of the pigment and its specific surface, coupled wih ability of the binder to wet and adhere to the pigment surfaces.

More complete cooking of starch at higher temperatures contributes very def-

TABLE XI

| Wheat Starch g | Additive g | Tearing Loss mg/loss per oz/yd² starch |
|---|---|---|
| 25 | none | 40-43 |
| 25 | 10 90° Fl, thin-boiling starch | 39 |
| 25 | 10 glucose | 15 |
| 25 | 5 urea | 31 |
| 20 | 5 urea | 42 |
| 15 | 10 urea | 51 |
| 25 | 0.5 $CaCl_2$ | 43 |
| 25 | 0.5 borax | 60 |
| 25 | 5 casein (in $NH_4OH$) | 59 |
| 25 | 5 karaya gum (+ borax) | 91 |
| 25 | 5 methyl cellulose | 39 |
| 22 | 3 methy'olurea | 18 |

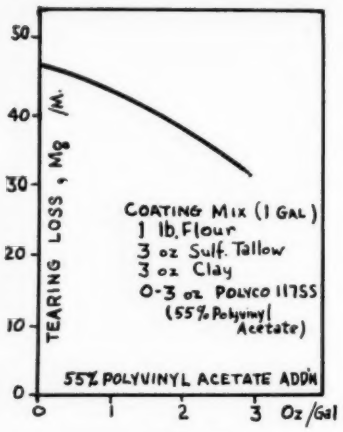


Figure 7
Effect of polyvinylacetate additions on pigment binding power

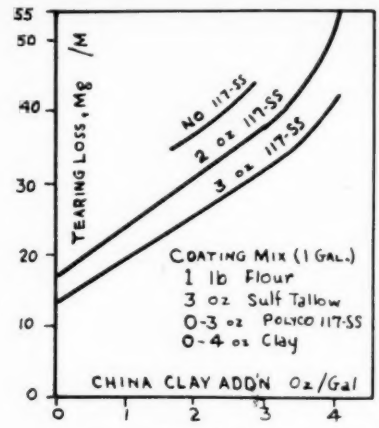


Figure 8
Effect of polyvinylacetate additions at various pigment ratios

TABLE XII

| Softener | Grams | Tearing Loss mgms/m per oz/yd² starch |
|---|---|---|
| Glycerine | 2 | 51 |
| Sulfated ester (22% $SO_3$) | 1.5 | 85 |
| Tallow | 1 | 90 |
| Sulfated castor, 75% (7% $SO_3$) | 1.5 | 133 |
| Sulfated castor, 50% (6% $SO_3$) | 2.2 | 110 |
| Sulfated castor, 35% (5% $SO_3$) | 3.2 | 120 |
| Stearic acid paste (25%) | 3 | 76 |
| Diglycol laurate S | 1.5 | 194 |
| Sodium oleate (Olate) | 1 | 194 |
| Sulfated tallow 75% | 1.5 | 103 |

initely to binding power as well as stiffening. Softeners reduce binding power in proportion to the amount used, but some softeners have more effect than others. Glycerin- and glycol-type softeners have the least effect on binding power, while soaps, sulfated castor oils, and tallows appear to reduce binding power more markedly.

Preliminary work on the effect of emulsion polymers in starch coatings has been carried out. The addition of polyvinyl acetate emulsion to starch mixtures resulted in a marked increase in pigment-binding.

A series of commercial starches have been compared for binding power by this technique. Wheat flour is found to be much poorer than wheat starch, probably in proportion to the amount of gluten present. Thin-boiling starches and dextrines did not give very satisfactory films and, for pigment binding, are probably valuable only in conjunction with other starches. Alkaline materials seem to have a deleterious effect on the binding power of starches — a phenomenon which, along with the interesting effect of soaps, should bear more detailed investigation. Small additions of methylolurea to starch, under the proper conditions, result in a remarkable increase in pigment binding power, and the resulting coating resists removal even by boiling water.

The effect of thermoplastic-resin emulsions was found particularly interesting, and a preliminary series of starch-resin mixtures showed great increases in binding power.

## ACKNOWLEDGMENT

The writer wishes to thank the American Polymer Company (Chemical Div, the Borden Co) for releasing the results of this investigation, as well as Interlaken Mills (particularly Ray Sherman, Arthur Green, and Joseph M Durand) for cooperation and assistance in establishing this test method and correlating it with plant practice.

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## *Tinctorial Strength—*

*(concluded from page P690)*

parent strengths. Possibly this is because the observer judging strengths actually carries in his mind an ideal white as the point of departure from which the colors of dyeings differ more and more as the strength of dyeing increases.

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## Appendix A

### DEPTHS DIRECTLY FROM TRISTIMULUS VALUES

Attempts have been made to find an empirical formula for calculating apparent strengths (depths) directly from the Tristimulus Values X, Y, Z, so as to save the time of obtaining Munsell notations.

So far the results have not been very promising. The best formulas so far obtained are sufficiently complex that what is gained by eliminating the steps through Munsell notations is lost by more complicated mathematical steps.

Also, though it has been found possible to obtain a formula which gives good comparative results for moderate-strength dyeings (as 2% of acid dyes on wool), this formula yields results for weaker dyeings (0.5%) not in good relation to the stronger dyeings. That is, unlike the formula with Munsell notations, the best formula found for calculation direct from X, Y, Z gives a ratio of depths corresponding to a constant (4:1) ratio of concentrations, which is rather inconstant and in some cases is represented by a very high power.

The best formula so far found, yet not good enough, is the following: Depth D is

$$D = \left\{(4v)^2 + K\,[7(V_x - V_y)]^2\right\}^{\frac{1}{2}}$$

or

$$D = \left\{(4v)^2 + K\,[20(V_x - V_y)]^2\right\}^{\frac{1}{2}},$$

whichever is the greater, where

$v = 10 - V_y$, $K = \frac{1}{1 + Y}$, and $V_x$, $V_y$, $V_z$ are

the Adams parameters corresponding to the conversion of X, Y, Z, respectively, to Munsell value units by means of the Nickerson tables *(6)*. One or the other of the two equations is used in different hue regions, and one can soon know in advance the approximate hue ranges in which to use the first or the second formula.

# PROBLEMS IN RESIN-FINISHING FABRICS*

ARNOLD SILVER

*Superintendent of Finishing Brewster Finishing Co*

The application of resin finishes on textiles is discussed by the speaker from the practical and technological point of view without chemical formulas or theory. He begins with a consideration of the purposes and uses of different finishes on various types of fabrics and continues with an explanation of the principles and steps followed in application. The most common problems and pitfalls encountered in resin finishing are discussed, including especially the question of catalysis, the development of odors, dyestuff fastness properties, dusting, uniformity, proper framing, and curing.

## INTRODUCTION

EVER since man has woven fabrics to meet his elemental needs, the problem of finishing fabrics has been with us. Fabrics are finished for one of two reasons: 1) to add properties of a utilitarian nature, such as crease proofing, water repellency, and shrinkage control, or 2) to enhance certain esthetic qualities which people have come to look for in fabrics, such as handle and appearance.

For a long period of time all finishing was done with the aid of natural products. A great many of these products are still used today. Indeed, some of the properties imparted by them can not be duplicated by our finest and most complicated synthetic chemicals.

With the turn of the century and particularly within the last twenty years, organic compounds prepared in laboratories were found to impart amazing properties to fabrics. Not only were the properties fabulous, but an exactness of chemical preparation was brought into the finishing end of the industry. We found that all the techniques of science could be used and that consistency of finish could be achieved to a degree never before attained. The development of synthetic resins has been one of the great contributing factors in the advancement of the textile industry.

The use of synthetic resins has brought along with its attributes certain problems, which the average finisher encounters daily. It is the purpose of this talk to present some of these problems to you as observed over a period of time and to discuss some of the solutions that have been found effective.

FACTORS AFFECTING CHOICE OF FINISH———Before a particular fabric is processed, the finisher might well look at his greige goods and do a little prior planning. It is very important to realize that the finishing of a fabric starts the moment the goods are laid out and not when, after many processes, the fabric reaches the finishing room. The cloth may be any one of many weaves. Each will require its own particular brand of finishing. If we are referring to gabardine, the important factors are whether it is of the sheen variety or whether it has a definite wale. It is also a foregone conclusion that the fiber content is extremely important since synthetic blends today range all the way from rayons, which are hydrophilic, to nylons and Orlons, which are hydrophobic, and to acetates, which are somewhere in between.

In addition, it should be realized that two fabrics with identical weaves, fiber content, and weight but coming from different mills have a tendency to finish differently. Adjustments in finish, therefore, are necessary to duplicate a required hand.

After an examination of his greige goods a finisher must anticipate certain problems that will crop up with the handling of the material prior to the actual finishing. He must obviously know the end use of his fabric, such as dress hand, ladies' suiting, men's suiting, outerwear, shirting, and slack finish, which are common types. As each person has his own conception of what any finish should be, it is always a good idea to have a concrete sample of the customer's requirements.

Regardless of the type of finish, then, we must realize that the quality of finish is of utmost importance. I am not only referring to water-repellent and crease-resistant finishes but to the type of water repellent, whether durable or nondurable. These things are partially determined by the price paid for the finish used. To be even more specific — price, type of hand, the mechanical equipment of the plant, and, finally and most importantly, the customer's request must be considered in determining which type of durable water repellent should be used.

The mechanical setup of each individual plant should be thoroughly understood by the finisher. Finishing fabrics is fully as dependent on mechanical equipment as it is upon the finishing chemicals themselves, and the two are completely dependent on each other.

The type of dyestuff to be used must always be taken into consideration. If a copper-ion technique is to be used, changes in resin content must be made in the finish.

The above are all problems that arise before the processing of the fabric begins. These should be gone into thoroughly to facilitate smooth operation and an even flow of goods through the plant.

The handle and appearance of a fabric will be affected by operations prior to the actual resin treatment. A proper singeing, the correct enzyme application and adequate setting time, the type of boiling off equipment, the dyeing operation and particularly the dyeing assistants used, and the method of drying — whether by cans, dry box, hot air clip frame, or pin tenter frame — all contribute to the final product and, hence, to the resin finishing of the cloth.

## APPLICATION OF RESIN FINISHES

Having either outright or inadvertently considered the preceding things, we come down to the actual resin application. Whether you are partial to the urea-formaldehyde or the melamine-formaldehyde condensates, or perhaps to newer modified urea-formaldehydes, or to the reactive type of resin, the same principle of resin application holds. A solution of the resin monomer is made. The strength of the solution depends entirely on the type of fabric to be treated, the desired hand and shrinkage control, or the crush proofing required. In many instances the monomer alone is sufficient, as far as the resin content goes, to give an adequate hand. More often than not a liquid polymer is added for additional body and firmness. The amount of polymerized resin varies greatly with the hand desired. Usually a small amount of cationic softener is used to round off the hand, to lubricate the fiber and in that way to increase the sewing strength of the material and to minimize harshness. If a water repellent is to be used, we generally leave out the softener for two reasons: First, the water repellent reacts on the fibers, in addition to its water-repellent properties, the same way a softener would react; and, secondly, since softeners are generally produced from fatty hydrocarbons, they tend to exhibit wetting characteristics, which obviously would be detrimental to a water-repellent finish.

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EFFECTS OF DIFFERENT WATER REPELLENTS ON RESIN FINISHES ———At no time in the past has the importance of water repellents been so emphasized. The public has become thoroughly acquainted with such terminology as durable water repellent and spot-and-stain-resistant finish. Water repellency has become a prime selling factor in dealing with synthetic blends. The price the converter pays for the finish determines whether or not a nondurable or a durable water repellent will be used. Of the durable types, we can use the quaternary long-chain hydrocarbon, which, when cured, will combine with the fiber itself. Zelan is an example of the type. As this kind of product exhibits great softening action, the long-chain resin polymer will have to be used in greater concentration than with other durable water repellents to overcome the softness.

Resin-based water repellents are also very popular. Because they contain a resin-forming molecule, the amount of liquid resin in the total formulation may be reduced to compensate for the resin in the water repellent if a comparable hand is to be maintained. There are several products of this kind on the market.

The latest development in durable water repellents is the silicone type. Because the silicones do not depend on a waxy chain, the greater the amount used the fuller the hand. To consider cost, however, firmness and fullness can be achieved by using the polymerized urea-formaldehydes, though to a lesser degree than when using the other classes of durable water repellents. We must modify this statement, however, because, in conjunction with the silicone resins, there is an emulsifier present which exhibits softening action. The amount of emulsifier and its softening effect in the particular silicone water repellent selected will therefore be an important factor in the softness of the final fabric.

CATALYSTS ——— A very important constituent in any resin formulation is the catalyst. Monomeric urea-formaldehyde and melamine-formaldehyde resins are applied to a cloth in order to obtain good penetration of the fibers of the rayon or cotton, although in such form they have no finishing effect. The conversion to a complex, cross-linked, infusible polymer within the fiber itself to obtain crush proofing and dimensional stability can be accomplished by high temperatures and time alone. We can cut this time to a minimum, however, by the use of catalysts. There are many types of catalysts and many theories as to which is the best one. The choice of catalyst depends entirely on each individual plant and the type of resin used. Some of the things to consider are the curing temperature, the stability of the impregnating bath, uniform resin curing and the necessity of curing at a normal operating temperature. For the sake of brevity I shall limit my discussion to the two common classes of catalysts, the ammonium and the organic-base catalysts.

The ammonium salts of mineral and organic acids function by the mechanism of the hydrolysis of the salt to liberate the free acid and by the oxidation of the free formaldehyde to give the free acid. Because of this reaction with the formaldehyde, the ammonium salts are usually buffered to give greater bath stability.

The organic catalysts react in much the same way as the ammonium salts. The great difference lies in the fact that there is no free ammonium ions present in the catalyst. As I will discuss later, ammonia tends to form amines, which in the tertiary form cause the fish odors that I hope none of you will have to contend with in the spring and summer of this year. It should be thoroughly understood that the organic catalysts require a higher curing time and temperature than the ammonium salts.

After the resin is applied, the goods must be dried and cured. As the weight of all the different fabrics impregnated will differ, so will the resin content. Hence, the time and temperature required for adequate cure will be different for each quality of cloth. It would be exceedingly difficult in the average synthetic finishing plant to have a different set of standards for all the various qualities. It is therefore very general practice for straight crease-resistant finishes to cure for four minutes at 300°F with an acid catalyst.

In the application of water repellents, particularly those of the durable type, with resin finishes, a temperature of 320° F should be maintained with the use of a catalyst. The time should also be lengthened so as to be sure not only of polymerizing the thermosetting resin but also of allowing the water repellent either to polymerize with itself, as in the case of the silicones, or, as in the case of the resin types, to combine, in part, with the cellulose fiber. If you undercure resins, you destroy the whole essence of resin finishing. You either lose crush resistance and dimensional stability completely or at least lose a part of it. At any rate, you are getting a poor job.

If you overcure, you tend to develop odors because the reaction of formaldehyde and ammonia salts at a prolonged high temperature is very conducive to the formation of trimethylamine, or fish odor.

WASHING———It is always advisable to afterwash resin-treated fabrics. Afterwashing removes any free formaldehyde, catalyst residues, as well as any odor. Washing should be done at open width with a detergent and alkali. Usually the open-width washer will contain three separate baths. The first will contain a detergent and alkali with a pH of about 9. The second bath should have a pH of approximately 8. The last bath should contain plain water for rinsing. It is advisable to have the bath water changing constantly.

It is obvious that, to wash correctly, the open-width washer should be in tandem with the drying equipment. If this is not so, further handling of finished cloth becomes necessary. There are many instances where, because of lack of equipment or space or both, afterwashing is not done. Yet, by failing to wash, you are assuming a calculated risk.

In the short amount of time alloted to me for so extensive a subject I have tried to cover the preliminaries of fabric preparation, the problems prior to resin finishing, the resin application itself, the curing and the washing. If all processes are done correctly, there should be no problems at all. It never seems to work like that, however, and problems occur all the time. What some of these problems are I will discuss, and I shall attempt to reach some solutions.

## SPECIAL PROBLEMS

Thermosetting resins, in particular the monomers, are used for rayon and cotton and to a lesser extent for acetate because of their ability to penetrate fibers and to polymerize within those fibers, thereby preventing shrinkage and giving excellent crease recovery. It should be realized that a surface polymer also has the ability to impart stabilization and, while surface resins are detrimental to crease recovery, they are beneficial to crease resistance.

As these are the reasons for using resins, a lack of the fully expected results from the use of resins constitutes our first problem. Along with this problem and probably even more common are uneven crease resistance and wrinkle proofing. Resin formulations to achieve these results are inescapably tied up with the mechanical equipment of the plant and the fabrics to be finished. Where in some cases a solution of urea-formaldehyde paste as low as 10% by weight is used, in others it is necessary to use as high as a 40% solution. After resin solution has been padded onto a fabric, uniform drying is necessary to prevent migration. Resin migration will eventually lead to uneven crease resistance and crease recovery. Even when a fabric is padded properly with a resin solution

and is dried correctly, only partial curing and hence only partial crush proofing and recovery will be obtained if there is uneven heating in the curing oven. An inadequate amount of catalyst will also tend to give only a partial cure and therefore only partial results. Curing at too low a temperature will also give only partial results.

ODOR——Undoubtedly the problem with the greatest psychological impact and with extremely serious consequences from a sales point of view is odor development.

Because of the peculiar fish-like smell and other indications, the odor is attributed to methylamines. Chemists have found that probably the easiest way to form methylamines on resin-treated fabrics is the reaction of ammonium radicals with free formaldehyde. Both may be abundant on a resin-treated cloth. Curing at too high a temperature for too long a time will be conducive to odor development. Another important factor in the cause of odor development would be predrying or curing the resin-treated cloth in a humid atmosphere. Free formaldehyde, once it comes in contact with water, will be difficult to remove. When there are humid conditions, therefore, the formaldehyde is kept in contact with the ammonium radical, which greatly promotes odor development. Good exhaustion is a big factor in preventing odor development in resin-treated goods. Since it is acknowledged that formaldehyde is a necessary ingredient in the formation of methylamines, we can assume that, by adding compounds to accept the free formaldehyde and thus to tie it up and keep it from reacting at a later date, we will have come a long way towards eliminating odor. Two compounds that have the ability to couple formaldehyde are urea and dicyandiamide. These products are of help but are not cure-alls. Since thermosetting resins contain nitrogen, extreme heat will cause degradation and amines will be found. Curing should therefore be carried out at as low a temperature as possible to give adequate results, that is, a full cure. Every fabric will pick up a certain amount of resin solids. It should be determined empirically based on prior performance, time, and temperature relation for curing. Please remember that 300°F is an arbitrary figure. Most loop dryers in this area are approximately 90 feet long and have a temperature reading in the center of the box. The temperature at either end of the box never approaches that of the center. This does not make much difference as long as on the final cloth there is a resin retention of somewhere around 85%. It is difficult to advise a specific temperature because it is impossible to separate this factor from the mechanical equipment which varies in each plant and upon which we base our time element.

PROPER CATALYSTS——Another factor that is important to consider in the avoidance of odors is the use of the correct catalyst. The idea behind the use of an organic catalyst is the theory that the less ammonium radicals in contact with free formaldehyde the less the chance of odor development. The obvious solution is to change the old standbys, ammonium salts, for organic amine salts. It is important not to go overboard, however, because these organic catalysts require increased heat and time in comparison with the ammonium salts. It is also a fact that, with extreme heat and time, the organic catalysts will also break down and aid in odor formation. One thing in the favor of these catalysts, however, is the greatly increased bath stability.

It has been found that, in making resin baths of large volume, the hand achieved at the end of a mix is harsher than at the beginning. We can attribute this to the fact that the bath keeps dropping in pH value because the ammonium-salt catalyst keeps hydrolyzing until it polymerizes the resin monomer into a long-chain polymer. When it is necessary to keep a resin bath for a prolonged time, the use of an organic catalyst is suggested. As an afterwash has been found effective in removing free formaldehyde, excessive catalyst, and uncured resins, all of which can produce odor at a later date, it is advisable to afterwash.

DYEING FASTNESS——A prime problem in resin finishing is the color changing of the fabric. In this instance the dyer and finisher must work closely. A dyer has no excuse to blame any color change on a resin finish. When an order calls for resinating, he must use dyestuffs that will change the least with resins. Before matching his final color, a sample should be dipped in the resin solution, dried, and cured. Only then should he check his final shade. Dyestuff companies will aid in the selection of colors that stand amine-formaldehyde resins. The important thing is to recognize the fact that colors may change with resins and heat.

Along with color change and the increasing requirement of colors to stand 160°F washability, we have the use of copper ions. These copper ions in conjunction with the resin must be put on in an acid media. Your resin bath naturally will not stand for any length of time in such a state. It is advisable, therefore, to make as small a mix as practical in order to keep the resin bath stable. After application and curing, these goods must be washed for two reasons: 1) to neutralize the acidity and thus to get the maximum wear out of the final garment, 2) to bring the shade up to the required color. It also must be remembered that, since copper-coupled dyestuffs are quite heavy, a great percentage of high-polymer resin can be left out if the same hand is to be maintained.

DEVELOPMENT OF DUSTINESS——A great many plants have the problem of fabrics dusting upon any mechanical action after resin treatment and curing. This constitutes a great problem because it will also occur when the garment is being cut and sewed. There are two theories why this happens.

The first theory is that the goods are not properly singed. When resin is applied, it quite naturally impregnates the tiny hairs and, upon curing, embrittles them. When the fabric is calendered and tubed these hairs break off and cause dusting. The other theory is that, upon drying, the resin migrates to the surface and then, upon subsequent curing and mechanical action, it powders off. The obvious solution seems to be a well-singed piece of goods. In addition, when drying a resin-impregnated fabric on a frame, elevating the temperature gradually will prevent resin migration. This will partially prevent dusting by keeping the resin from migrating to the surface.

Another problem, though a minor one, is the production of a resin-treated fabric that finishes with a beautiful hand in the center and with soft, raggy selvedges. This can be corrected by framing the fabric approximately one-half inch above the actual finished width after application of the resin. Upon curing, the fabric will shrink in width from one-quarter to one-half inch. When the goods are finally framed, the finished width is attained without pulling the cloth. A resin finish is broken down at the edges when a cloth is framed wider than the width at which it should be set.

In the past few years the use of cotton has jumped from a utilitarian to a luxury fabric. Because of its strength and diversity many different things can be done to cotton that cannot be done to other fabrics.

Cotton, like rayon, is hydrophilic and swells in water. This causes it to shrink. With the development of synthetic resins, the stabilization of cotton became practical, and new horizons were opened.

The same principles of resin application hold for cotton as they do for rayon. The only difference is that on cotton there is usually a mechanical operation to give a novel effect. If the mechanical novelty is applied after the resin is padded on the fabric but before the resin is cured, and the curing takes place after the mechan-

ical action, the fibers are locked in whatever novelty is chosen to be put on them. This can of course be carried out only within certain limitations.

It should be remembered that cotton can be given a high glaze and can be embossed without the aid of resins. The results in this instance can hardly be differentiated from those with resin-treated fabrics, but such a job will not stand washing or even wetting. The resin or reactant is used for dimensional stability and functions because it prevents swelling in water.

As was mentioned previously, the same principles hold for the resin impregnation of cottons as they do for the synthetic fibers. Different weaves, weights, constructions and greige styles must be considered. Each will handle differently.

When finishing plants in this area handle cottons, chances are that the preliminaries of the cotton processing are done elsewhere. If this is the case, cotton goods for processing may be gotten plain, or perhaps mercerized, or perhaps even finished. Cotton goods are usually plain-finished with gums and starches. Putting resins on cloth of this type may be done, but only hazardously. The resin has a tendency to remain on the surface and to give a stiff finish with poor stability and embrittlement. Such cloth may have to be desized and washed before resin treatment. A mercerized cotton has the strength and the rich luster, after finishing, that is best suited to the trade, although a plain cotton will also finish well.

The principle that dyestuff affects a finish holds for cottons as well as for rayons. Cottons may be vat-dyed, naphthol-dyed, sulfur-dyed, direct-dyed, or pigment-padded. Sulfur colors usually finish firmer than the others. Pigment-padded colors contain a binding resin that effects the hand.

Drying will effect resin treatment, but if the cottons are received from a bleachery unfinished, they are probably can-dried. Cottons dried on a frame or loop dryer are more absorbent than those dried by other methods, hence, it is important in resin application to take account of differences in absorbency before resin treatment.

In treating cottons with resins there is again a choice of urea formaldehydes, modified urea formaldehydes, reactant-type resins, or melamine formaldehydes. Each will work well, although certain types have a marked advantage. For greatest durability a combination of external and internal thermosetting resins is best. A cellulose reactant plus a water-soluble polymer, such as polyvinyl alcohol, may be employed. The polymer is insolubilized by the reactant. This type of finish gives a certain degree of stiffness. Where a soft finish is desired, the reactant type gives the greatest durability as well as the greatest softness. A softener should always be incorporated in the resin bath. This lubricates the fibers and prevents chafing during subsequent mechanical treatment. In the case of cottons it also increases tear strength and tensile strength, which are decreased by the use of thermosetting resins.

EFFECTS OF MOISTURE CONTENT———In padding a resin finish and subsequently in drying the fabric it is best to leave a certain amount of moisture in the cloth. This is done for several reasons. Primarily, it insures that the monomers are not polymerized. Secondly, it gives a pliability to the cotton that enables it to be distorted without tendering. The more moisture in the fabric when it reaches the embossing roller, the firmer and crisper will be the finished cloth. It is usually said, arbitrarily, that between 12 and 15% of moisture is needed for deep embossing and about 8 to 10% for Schreinering or chintzing. The Schreinering and chintzing moisture is critical, as it makes the difference between a firm, boardy hand and a nice, full, heavy hand.

MECHANICAL FINISHING———Let me define quickly the different types of mechanical handling. First, there is deep embossing. There is a male steel roller that has been run into a paper, paper-wool, or combination cotton and paper-wool roller so as to leave a deep impression. The fabric is then run between the two so that it can take on this fashion. Color can be applied in the form of a pigment on the fabric since it adheres to the paper roller after being embossed. This is called tipping. Another version of this is to apply the color to the steel cylinder and to deposit it in the valleys of the embossing. This is known as valley printing or inking.

Another type of mechanical handling is Schreinering. This is done by means of a specially engraved roller on which the lines run approximately at a 20° angle and which are usually spaced with 150 to 500 lines to the inch. The effect of this is a rich, deep-seated lüster. The fewer lines there are to the inch, the higher the luster. Schreinering is done with high roller pressure, usually upwards of about 60 tons.

Chintzing is the running of the fabrics between a steel and a paper roller geared so that the steel roller turns faster than the paper roller. This imparts a high glaze to the fabric.

The heat and pressure of the calender rollers are determined greatly by the type of machine that is being run. Heat for all cotton treatment runs to about 350°F, while pressure will depend on the diameter of the steel embossing rollers. If the pressure is too great and the steel roller diameter is small, a bending of the steel will occur, which will put a crown in the paper and could lead to uneven embossing. It must be remembered to break in the paper at approximately the heat expected in running the cottons.

In the mechanical handling of moist cloth, shrinkage must be expected. It is imperative, therefore, to frame the cloth before mechanical handling from one-half to one inch more than the finished width. Once the embossing, chintzing, or schreinering is cured, the width can be pulled out only with a detrimental effect on the cloth.

Printed fabrics are used to a great extent in the mechanical handling of cottons. The only requirement is an obvious one: they should not mark off and repeat with each revolution of the steel roller.

A fashion that was prevalent many years ago and which has again come into vogue is the printing of a thermosetting resin along with color and a catalyst. The fabric is then glazed in the usual fashion and cured. Upon subsequent washing the print that has the thermosetting resin will remain lustrous, while the remainder of the cloth will swell and be delustered.

The handling of cottons is a specialized operation. The entire resin treatment must be geared to running on an entirely different fabric, of course, when the cotton operation comes into a synthetic-cloth finishing plant. Frame speed is greatly increased, moisture is critical, heat of curing and time are much more vital than in doing the synthetics. In short, the whole procedure must be closely watched.

## CONCLUSION

I have tried in a comparatively short period of time, to cover a topic on which whole textbooks have been written. Each individual subject could be expanded into a full discussion. Through necessity I have intentionally left out discussing such classes of resins as the thermoplastic and the alkyd. In England the latter class has much wider use than is practiced in our country, perhaps justifiably so.

I have tried to stay away from the exact chemistry of the subject as much as possible and to talk on a practical level because I believe that such a talk could be given by men in our organization much better qualified than I.

Every day new developments threaten to make present methods obsolete. It is stimulating to be connected with an industry that is dynamic. A textile plant must be flexible and progress with the changes that are continually being made.

# ● ABSTRACTS ●

## The Future of the Natural Fibers

A J Turner, *J Textile Inst* 45, P317-27, July, 1954.

The author points out that there are hundreds of natural fibers, but the outstanding ones of great industrial importance are silk, wool, cotton, flax, jute, hemp, ramie, and sisal. He lists their characteristics, uses, and sources of supply, and gives figures showing the specific gravity, mean length and width, and fiber strength of the various types, and details of their chemical composition and their production and prices covering the period 1931-1952.

To predict the future production of the textile fibers in general, and of the natural fibers in particular, according to the author, involves an economic forecast, an exercise in the problems of supply and demand.

Taking the problem of demand first, it is related to the growth of population; a larger world population will need more textiles. Estimates based on the present rate of increase give the following figures for world population by the end of the present century:

| *Year* | *World Population* |
|---|---|
| 1950 | 2,400,000 000 |
| 1975 | 3,100,000,000 |
| 2000 | 4,000,000,000 |

From these figures it is evident that the demand for textile fibers by the end of the century is certain to be tremendous, and likely to tax all sources of supply to the utmost. Even to maintain the present standards per head of population, the world requirements of textile raw materials should be 29 percent greater in 1975 than in 1950, i e, greater by 8,181,000,000 lbs.

As regards the sources of supply, the author states that it is not a simple matter to make a direct estimation of the production of the natural fibers, because the farmers who produce them can to some extent adapt themselves to the demand and switch to more remunerative crops if a low demand for textiles leads to weak prices for the raw materials. Where there is danger of food shortage, farmers will no doubt tend to alter their crop programs accordingly.

The author predicts that the natural fibers as a group will still be holding their own in 1975, and he will not be at all surprised if some of them are then being produced in still greater volume than in 1950.

It is evident that there will be a great expansion of the man-made fibers in the next 25 years, particularly rayon and acetate, largely because they are the cheapest to produce. This expansion will depend in part on an adequate supply of raw materials, and whether it will be sufficient to maintain even the standards of the present day throughout the world is very doubtful.—WHC

## Cotton Finishing Developments

A Bolgiani, *Dyer* 111, 877-82, 955-61, June 11 and 25, 1954.

This is a long and very complete review of the whole subject of dyeing and finishing of cotton, which is particularly interesting because it gives the European viewpoint. It was read at the International Cotton Congress in Buxton, England.

The author discusses dyeing of cotton in the loose state, in the form of card sliver, on yarn, and on packages. High-temperature dyeing is also referred to; here the author cautions that many dyes, particularly vat dyes, are damaged at temperatures above 100°C. Automatic yarn mercerizing machines and the sizing of cotton yarn are also mentioned.

Turning to cotton cloth, the author discusses singeing, kier-boiling, bleaching, mercerizing, and various methods of dyeing, including the modern continuous processes. Some of the more recent developments in printing are described briefly.

A wide variety of finishing processes is mentioned, including treatments with resins and other materials to produce crease-resistance, water-repellency, embossed effects, etc. Parchmentizing with acid, acetylation, and other permanent transformations of the cellulose fiber are included. The review ends with a discussion of shrinkage-control methods.

It is suggested that the article be read in its entirety.—WHC

## Some Aspects of the Chemistry and Textile Uses of Sequestering Agents

J V Summersgill, *J Soc Dyers Colourists* 70, 278-83, *July* 1954

In many treatments to which textiles are subjected, trouble often arises from traces of certain metals. These effects are caused when the metal is present in the usual form of a cation (positively charged). Faults caused by metals can often be avoided by the use of certain chemicals which react with the metal in such a way that it becomes part of a complex anion (negatively charged). When the metal is in this form, its tendency to cause undesirable results is inhibited or prevented. Such compounds are referred to as *sequestering agents.*

To be useful commercially as a sequestering agent, a compound must meet certain requirements. The main ones are:

1) It must form a complex which is stable under the conditions of use.
2) It must be suitable for handling in bulk.
3) It must be capable of being manufactured economically and in commercial quantities.

The compounds that have been marketed commercially chiefly for this purpose may be divided into two types:

1) The complex phosphates (e g, sodium triphosphate, $Na_5P_3O_{10}$, and sodium hexametaphosphate, $Na_6P_6O_{18}$).
2) Derivatives of iminodiacetic acid, $NH(CH_2COOH)_2$ ( e g, ethylenediamine tetra-acetic acid and nitrilotriacetic acid).

The chemical reactions of type (2) with calcium, forming calcium complexes, are illustrated by the author, who states that the complex-forming action of the phosphates is probably similar in character to that of the iminodiacetic acid derivatives.

Ethylenediamine tetra-acetic acid has been extensively studied in recent years. It forms complexes with alkaline-earth and heavy metals, and even with lithium and sodium weak complexes are formed.

The major use of sodium triphosphate and hexametaphosphate is in scouring and other cleansing processes by sequestering calcium and magnesium. Sodium hexametaphosphate also prevents precipitation of certain direct dyes in hard water. Similarly, ethylenediamine tetra-acetic acid prevents precipitation by calcium of certain wool dyes.

In this connection it should be remembered that when sequestering agents are used in dyeing or other processes involving treatment at a high temperature, sodium hexametaphosphate gradually changes to sodium orthophosphate on boiling, thus losing its sequestering properties. The change is more rapid in the presence of acid or alkali. Iminodiacetic acid derivatives are stable to prolonged boiling.

The sequestering agents are useful in preventing damage due to iron, either in the water or from machinery, which affects the color of many dyes. The author discusses the relative merits of the various types in this connection, and states that under slightly acid conditions ethylenediamine tetra-acetic acid is the most effective agent for preventing off-shade effects caused by iron. This product will also remove iron stains from wool with the addition of an organic acid (e g, oxalic acid). It also prevents off-shade results due to copper, but is rather ineffective in removing copper stains from wool.

The author also discusses briefly the application of the sequestering agents in analytical work.

Sixteen references to the literature are included.—WHC

## • Oakite Opens New Laboratories in New York

Oakite Products, Inc, threw open the doors to their new and expanded laboratories at 350 Hudson St, New York, last month, affording visitors a look at the 30,000-sq ft installation devoted to research and product development in chemical cleaning. John A Carter, president of the concern, and J J Basch, manager of research and product development, were on hand to welcome the viewers.

The laboratory is subdivided into three major sections — product development, customer service, and engineering. In addition, a complete pilot plant is planned for the small-scale manufacture of detergents and solvents prior to field testing.

The chemical research laboratory, manned by a staff of chemists and chemical engineers working in 11 laboratories, spearheads all new product developments.

Each laboratory is set up with equipment to aid in the study of various soils and the effect different cleaners have on them. Among the precision instruments shown were a tergitometer, which was used to test the cloth-washing effectiveness of a single product 10,000 times; reflectometers, an ion-exchange separator, polarizing and ultra-microscopes, and numerous fine balance instruments.

Materials and methods used for cleaning in textile mills were very much in evidence. Also on display were items of pressure-spray equipment used for cleaning textile machinery.

Of particular interest in the solvents laboratory was an experiment being conducted with the newly developed Oakite Composition No. 116. An electric motor, with the current switched on, was immersed in a beaker of the new safety solvent, and no shorting-out occurred. A flame, passed across the open mouth of the beaker, did not ignite the vapors of the solvent. Regulation ASTM equipment was being used to determine flash points. Heavily soiled machine parts were cleaned with various solvent compounds to determine relative cleaning abilities.

A trip through the customer service laboratory revealed a wide assortment of equipment used to simulate actual production methods: two-, four-, and five-stage automatic washing machines, a complete electroplating line, various burnishing and barrel-finishing equipment, salt spray chambers, humidifying cabinets, etc.

In the area ear-marked as a future pilot plant, a display was set up to show the 30 different pieces of cleaning equipment designed and manufactured by the engineering laboratory. Equipment displayed, which ranged in size from a five-ounce acid-pouring spout to a 328-pound interior tank cleaning unit, included solution spraying units, steam detergent guns, solution control and temperature metering devices, and proportioning equipment.

**John A Carter, president of Oakite Products, Inc, surrounded by members of the company's research and product development staff, pulls the switch to open the firm's new laboratory facilities in New York.**

An official spokesman stated that the new laboratories, while equipped to handle any problem industry might presently have, would eventually go on to even greater internal expansion to match the increasing complexities that crop up in industrial cleaning. He stated further that industrial cleaning is a rapidly expanding industry, and that research and product development are its very life blood.

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## • Colgate-Palmolive Establishes New Radioisotopes Lab

Through the cooperation of Rutgers University, whose Wright Chemical laboratory is nearby, the Colgate-Palmolive Company, Jersey City, N J, has established a new radioisotopes laboratory for basic research in soaps, detergents, and toilet articles.

The new installation, located in New Brunswick, N J, uses isotopes as tracers in laboratory tests to determine how various ingredients work. The information obtained will be used to develop improved formulas and more efficient manufacturing processes.

To head the laboratory, Colgate has appointed Dr Manno F Nelson, who has carried out isotope research at the University of Iowa.

## • B F Perkins Names Carolina Distributor

B C Trotter, Jr, manager of the Southern Sales Division, B F Perkins & Son, Inc, Holyoke, Mass, has announced the appointment of the Hayes and Richardson Co, Spartanburg, S C, as a distributor in South Carolina and western North Carolina.

The new association follows the recent establishment of the Southern Sales Division in Charlotte, N C.

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## • Inderfurth to Represent OBSW in South

The Original Bradford Soap Works, Inc, West Warwick, R I, last month announced the appointment of Karl H Inderfurth Co, Charlotte, N C, as sales representatives in the South.

The Charlotte firm will manage the sales and service of all products relating to the textile industry in the southern territory. Technical assistance from Original Bradford Soap Works, Inc's research and development staff will be available at all times.

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## • NSP-Corn Processing Merger Under Discussion

Frank Greenwall, President of National Starch Products Inc, and Richard Moss, Chairman of the Board of Clinton Foods Inc, in a joint statement recently confirmed that discussions are taking place looking to a merger of the Corn Processing Division of Clinton Foods with National Starch Products. No final agreement has been reached.

## • Hooker Sales Meeting

Hooker Electrochemical Co held its annual sales meeting last month at the company's main sales office at Niagara Falls, N Y, where sales plans for the coming year were outlined and various members of management discussed matters of interest in their respective fields. The group of 89 men who attended the morning and afternoon sessions was comprised of field salesmen, supervisors, district sales managers, representatives of sales agents and of the company's advertising agency and interested personnel from the local plant. All branch sales offices at New York, Chicago, Tacoma, Los Angeles and Worcester were represented.

Chairmen of the morning and afternoon sessions were Robert E Wilkin, vice president and general sales manager; Bjarne Klaussen, executive vice president; John S Coey, eastern sales manager; Herbert Heesch, field sales supervisor and William H Monsson, caustic soda-chlorine sales supervisor.

One of the highlights of the meeting was a sound and color film entitled, "Selling and Advertising in the Changing Industrial Market."

On September 15, R Wolcott Hooker, vice president, and Mrs Hooker entertained the group at their home, Barton Hill, in Lewiston for cocktails and a buffet supper.

After a buffet lunch on September 17 at the Niagara Falls Country Club the group played golf in the annual sales department conference invitation tournament.

A dinner at the country club following the tournament was highlighted by a testimonial to William F George, New York district sales manager, who retired at the end of the month in line with the company's retirement policy.

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## • Proctor & Schwartz Divisional Consolidation

Proctor & Schwartz, Inc, has consolidated its Drying Machinery Division and its Textile Machinery Division, previously operated with entirely separate sales organizations and with separate engineering departments. These functions will now be combined, with Harmon B Riehl as vice president in charge of all sales effort.

The engineering work will be separated into a Product Engineering Department, under John W Powischill, and covering all products. The other engineering group, under Jack P Wilson, will be responsible for all Research and Development programs.

All publicity work, advertising, exhibits and public relations will be in charge of John H Senior, vice president.

## • Carbide and Carbon Building Oxo Chemicals Unit

Construction of a new unit to produce more than 60,000,000 pounds of chemicals per year by the Oxo process at the Texas City, Texas plant of Carbide and Carbon Chemicals Company, a Division of Union Carbide and Carbon Corporation is nearing completion. It will be one of the largest in the world employing the Oxo process for the synthesis of chemicals.

Using the extremely high-pressure reactions of the Oxo process, a large family of new alcohols, aldehydes, and acids will be added to the more than 400 synthetic organic chemicals now produced on a commercial scale by Carbide and Carbon. At the present time commercial quantities of seven new Oxo chemicals are already being produced in pilot plant facilities at the South Charleston, W Va plant. With the initial operation of the new large scale commercial unit the manufacture of many of these will be transferred to Texas City. Production of iso-octyl alcohol, primary decyl alcohols, and primary tridecyl alcohols is planned for the initial operation of the unit, which is scheduled to start this month.

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## • Guardian Completes Expansion Plans

Guardian Chemical Corporation, 10-15 43rd Ave, Long Island City, N Y, has announced the completion of its plans for expansion, and holds that it now carries the world's most completely diversified line of germicides, fungicides, viruscides, algaecides, slimicides, sporicides, bacteriostatic agents, and chemical inhibitors of mold, mildew and dry rot.

Guardian began operations several years ago with the introduction of Clorpactin, a powerful nontoxic and nonirritating germicide and fungicide. Their Dynactol, which has been used effectively for stripping dyes from rayons and acetates without undue loss of tensile strength, appears under several trade names of the various franchises.

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## • LTI Library Receives New Gifts

Joseph V Kopycinski, librarian at the Lowell Technological Institute Alumni Memorial Library, has announced the receipt of two noteworthy gifts.

The firm of Dike, Thompson and Sanborn, patent lawyers in Boston, donated 350 bound volumes of the Official Gazette of the U S Patent Office covering the years 1841-1920.

George Fuller, a New York textile consultant, has donated his library of 113 books on textiles.

## • Symposium on Fundamental Fiber-Fabric Relationships

Polytechnic Institute of Brooklyn will sponsor a symposium consisting of six conferences on "Fundamental Fiber-Fabric Relationships" in conjunction with its centennial celebration. The symposium will be sponsored by the Polymer Research Institute, which is headed by Herman Mark. The program is being organized by Jack J Press, fiber specialist.

With one conference scheduled each month from November through April, the symposium will attempt to develop a greater understanding in the use of textiles by bringing together scientists, engineers and executives to discuss synthetic fiber problems. Each conference will be held at the Brooklyn Polytechnic Institute under the chairmanship of a noted leader in the field.

The following conferences and chairmen have been announced, with the other participants and papers to be revealed later: "Intrinsic Fiber Properties," Saturday, November 13, 1954, W W Heckert, Du Pont Co; "Fiber Form Factors," Saturday, December 11, 1954, Walter J Hamburger, Fabric Research Laboratories; "Fiber Interactions," Saturday, January 8, 1955, John H Dillon, Textile Research Institute; "Blend Engineering," Saturday, February 4, 1955, Carl A Setterstrom, Carbide and Carbon Chemicals Co; "Fiber-Yarn-Fabric Relationships," Saturday, March 5, 1955, Milton Harris, Harris Research Laboratories; "A Challenge to Industry," Saturday, April 2, 1955, J B Goldberg, consultant.

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## • Sterox Manufacture Shifted to Everett

The manufacturing of Sterox SE and Sterox SK, detergent agents used largely in the textile industry for wool scouring, has been moved to the Everett, Mass, plant of Monsanto Chemical Company's Inorganic Chemicals Division. The production move from the company's Anniston, Ala, plant is aimed at bringing manufacture of the products closer to the location of the principal consumers.

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## • Film on "Flamefoil Canvas Protection" Available

The free-loan color motion picture "Flamefoil Canvas Protection" is once again available through The Princeton Film Center, Inc, Princeton, N J. It is a dramatic demonstration of the safety and servicibility features of fire-, mildew- and water-resistant canvas, which may be utilized in industrial or public service operations, under varying climatic conditions and situations.

"Flamefoil Canvas Protection" is sponsored by The Philadelphia Textile Finishers, Inc.

**Nopco industrial sales meeting, Harrison, N J**

***Front* (l to r): L E Rossiter, T V Rankin, B A Schiller, W B Morehouse, W E Brewer. *Rear:* (l to r): O E Lohrke, E A Robinson, R F Spain, J N Gammon, H A Swanson, R B Macintyre.**

## • Nopco Holds Industrial Sales Meeting

Introduction of a new series of polyvinyl acetate emulsions for adhesives, paper and textiles was a high point of the recent industrial sales meeting between divisional and district managers of Nopco Chemical Company, Harrison, N J. Nopco uses this semi-annual meeting for the presentation of new product developments and to discuss the industrial problems which will serve as a basis for future research projects.

A guest from the Research Institute of America, Blaine Britton, spoke on "Overcoming Objections in Selling." This was followed by a movie on the same theme. Irene Dennery, Nopco's advertising and sales promotion manager, reported on the sales backing which the company is giving through its advertising program. Talking on account servicing and general production was Harry A Batley, assistant vice president; Robert Urich, manager of the Budget Department, discussed sales performance and sales goals.

Further sales conferences and recreation at Pocono Manor in the Pocono Mountains completed the six-day session.

## • CCNE Fall Outing

The Chemical Club of New England, Inc held its fall outing at the Oyster Harbors Club, Osterville, Mass, last month, with CCNE president Howard Cookingham of D H Litter Co, Inc, as host.

Feature event of the outing was a golf tournament, while William Mann, Geo Mann & Co, Inc, made his power cruiser available to those who preferred to fish.

The Entertainment Committee consisted of John E Upham, Jr, Hercules Powder Co, *chairman;* Thomas J Desmond, Du Pont Co; and William B Sinclair, Celanese Corp of America.

## • New R & H Service Office

Rohm & Haas Co, Textile Chemicals Department, has opened a new service office at 254 E Paces Ferry Rd, N E, Atlanta 5, Ga. Phone: EXchange 8046.

## • Borden's Opens Distribution Center in N C

To meet the increased formaldehyde needs of chemical and textile industries in the South Atlantic states, the Borden Company's Chemical Division has opened a new distribution center at Kernersville, N C, thereby supplementing two other Borden formaldehyde shipping points in the East, i e, the Company's manufacturing plants at Bainbridge, N Y, and Demopolis, Ala.

The new center now permits Borden to offer tank-truck deliveries of formaldehyde along the entire eastern seaboard, with the exception of the northern tip of Maine and the southern tip of Florida.

## • New Contracts Awarded NCSC Department

The awarding of two new textile research projects by the U S Air Force and an industrial concern to the Department of Textile Research, School of Textiles, North Carolina State College, was announced recently by William A Newell, research coordinator at the school. The projects have a total value of $50,000.

The contract awarded by the U S Air Force through Wright Air Development Center involves a study of chemical degradation of nylon and Dacron parachute fabrics.

According to Henry A Rutherford, director of chemical research and project leader, fundamental information of chemical degradation of nylon is not available, and this project should yield information useful not only to the military but to industrial producers of nylon fabrics and garments. It is anticipated that the project will require about one year.

Two synthetic-fiber producing firms have awarded contracts for a study of the effects of nuclear radiation on textile fibers, polymers, and fiber-forming materials, to be conducted in cooperation with the staff of the nuclear reactor in the School of Engineering at N C State. Previous research has shown that textile fibers may be improved or degraded in their properties by exposure to nuclear radiation, and the purpose of the research will be to explore these effects further.

## • Production Begins at Solvay's New Chloromethane Plant

The start-up of production of its chloromethane plant at Moundsville, W Va, signalling the addition of four new products to its line of alkali chemicals, has been announced by Solvay Process Division, Allied Chemical & Dye Corporation.

The new plant, which has been under construction for over a year, will produce methyl chloride, methylene chloride, chloroform and carbon tetrachloride.

Methyl chloride will be sold in tank car lots, fob Moundsville, W Va, freight equalized with recognized producing points. Methylene chloride, chloroform and carbon tetrachloride are being offered on a delivered price basis. These products may be obtained in drums or in tank car quantities.

In addition to its four new products, Solvay has been producing chlorine and caustic soda at Moundsville since last December, and is now also making by-product muriatic acid and anhydrous hydrogen chloride at that location.

## • Bangor Mills Adds Participants to Pension Plan

Many additional employees this year have become participants in the pension plan of Bangor Mills, Inc, with plants at Pen Argyl and Bangor, Pa. The expense of the plan is borne exclusively by the Company.

Contributions by Bangor Mills, Inc to the plan now exceed $436,000, it is reported. In addition, employees are covered by death benefits aggregating approximately $1,500,000. Bangor Mills, Inc, is said to have paid this year $86,771.00 as premiums for policies now in force.

The plan, which has been in effect since 1944, is administered by a Pension Committee composed of Albert J McMasters, office manager; Ellisworth Davies, Finishing Dept superintendent; J Lawrence Davis, attorney; Meyer H Korn, president; and Charles H Weiss, American Pension Co.

## • BTA Opens Toronto Office

Barnes Textile Associates, Inc, Boston, Mass, has opened an office at 19 Melinda St, Toronto, Ontario, to provide consulting engineering service for Canadian textile mills.

Fred E Stone, who has conducted engineering work for BTA in Canada for the past two years, will be stationed at the new office. Service to Canadian firms will be supervised by Nathaniel M Mitchell as proprietor of Barnes Textile Associates, International, which was organized to serve clients outside the United States.

# NEW PRODUCTS AND DEVELOPMENTS

## • DePaul Develops New Bleach Assist

Depco Bleach Assist, a newly developed stabilizer for use in conjunction with sodium chlorite bleaching, has been introduced by De Paul Chemical Co, Inc, 44-27 Purvis St, Long Island City 1, N Y. It is designed primarily to overcome the disadvantages of using sodium chlorite in the bleaching process by controlling the separation of the toxic chlorine dioxide which is developed in the reaction between bleaching salt and acid and preventing its loss.

The new product also incorporates protective salts to minimize the corrosive action of chlorine dioxide in acid baths.

Directions for correct use, as to concentration, temperature, time and selection of acids, will be supplied by the manufacturer on request.

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## • Verona Announces Four Isolan Colors

Verona Dyestuffs, a Division of Verona Chemical Co, Union, N J, has announced the availability of four new Isolan colors manufactured by Bayer & Co. They are: Isolan Yellow RLS, Isolan Orange RLS, Isolan Grey BRLS and Isolan Bordeaux RLS.

Each of these metal complex dyestuffs is said to possess outstanding light fastness and excellent fastness to wearing and processing. Their suitability for dyeing in weakly acid dyebaths (pH 5-6.5) and their uniform development on the fabric are cited, along with the short dyeing time required in their application. Verona suggests their use in maintaining the best possible quality and handle.

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## • Further Reduction in Triton Prices

Another reduction in the prices of one of its most widely used surface-active agents, Triton X-100, was announced on Sept 20th by Rohm & Haas Company. Ranging up to more than 10 percent, the reductions amount to 2½ to 3½ cents a pound.

Corresponding reductions in the prices of three other surface-active agents manufactured by the company, Triton X-102, Triton X-114, and Triton X-138, became effective at the same time, the third major reduction this year in the prices of these nonionic grades of the Triton series.

## • "Silica Soot" Being Manufactured Semicommercially

"Silica soot," an almost chemically pure silicon dioxide with a particle size of only 10 to 20 millimicrons, is now being manufactured semicommercially in this country by Dow Corning Corporation, Midland, Mich. Its use as a textile finishing additive is suggested. Identified as Dow Corning Silica, it is produced by burning silicon tetrachloride in the presence of combustible gases, a process invented at the Corning Glass Works in 1933-36 by Dr Frank Hyde, now of Dow Corning.

Dow Corning Silica is said to exhibit a higher degree of purity (99%) and particle separation than silicas formed by precipitation processes. Individual particles reportedly are well defined and non-agglomerating, permitting the material's surface area and oil-absorption properties to realize maximum effectiveness. It is said to be easily dispersed in elastomeric compounds and in solvent, oil, or water-based systems.

Currently priced in the range of $0.80 per pound, it is shipped in the form of fairly uniform, friable pellets that are essentially dustless and easy to handle. Free samples and literature are available from the manufacturer on request.

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## • McKiernan-Terry Displays New 40-Ton Multipurpose Calendar at Greenville

A new embossing, schreiner and friction calender with a loading capacity of 40 tons was displayed for the first time at the Southern Textile Exposition in Greenville, S C, October 4th to 8th, by McKiernan-Terry Corporation of Dover and Harrison, N J, manufacturers of calender rolls and textile finishing machinery.

The keen interest displayed in the heavy duty, 75-ton Multi-Purpose Calender, shown last April in Atlantic City, was followed by requests for a lighter-duty machine embodying all of the basic features of design and convertibility of the heavy duty calender.

As with the heavy duty McKiernan-Terry Multi-Purpose Calender, the replacement of mating gears, required in conventional designs for varying combinations of embossing rolls, has been eliminated. One set of gears, running on correct pitch lines, is provided for the entire range of rolls.

For embossing services, an entirely new design for tipping and inlay applications has been developed.

## Seyco-Merce CP

Seyco-Merce CP, a newly developed blend of alkali-soluble penetrants designed for maximum penetrating effect in the range of caustic solutions used for plisse printing, has been introduced by Seydel-Woolley & Co, Atlanta, Ga.

The product is said to be soluble and stable while adding very powerful wetting action to caustic solutions or caustic printing paste; thus the caustic penetrates the goods rather than spreading on the surface, thereby resulting in sharper definition. It reportedly has no detrimental effect on the thickeners normally used for plisse printing, and it is claimed to be more economical than most competitive agents suitable for this purpose.

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## • National Introduces Two New Colors

National Aniline Division, Allied Chemical & Dye Corp, 40 Rector St, New York 6, N Y, has announced the addition of National Nacelan Pink 3B, an anthraquinone disperse dye, and National Carbenthrene Yellow PG Double Paste, an anthraquinone vat dye, to its line.

According to the manufacturer, National Nacelan Pink 3B produces, when dyed or printed on acetate rayon, bright shades of pink and bluish red. Applied to nylon, the colors obtained are much bluer than those produced on acetate, with somewhat superior fastness properties. It may also be used to color Dacron either at high temperatures or at the boil with a suitable carrier. It reportedly possesses very good to excellent fastness to perspiration, acid, alkali, water, sea water and hot pressing, and good fastness to light.

National Carbanthrene Yellow PG Double Paste produces moderately bright reddish shades of yellow when dyed on cotton or rayon. The manufacturer points out that this dyestuff is applicable by all methods of dyeing in open tubs, on the continuous range, in package machines, and, as it is unaffected by the presence of metals in the dyebath, it can be applied in iron machines with practically no dulling. National Carbanthrene Yellow PG Double Paste reportedly exhibits excellent fastness to all wet processing, including bleaching, cross dyeing and perspiration. It is especially recommended by National Aniline for coloring materials that are to be resin finished for crease resistance, as its very good fastness to light is definitely increased by such treatment.

# NAMES IN THE NEWS

In a move which is said to be aimed at future diversification in the scope of the firm's activities, FREDERICK C SCHOLLER has become chairman of the board of Scholler Brothers, Inc, Philadelphia, and LLOYD O KOONS has assumed the firm's presidency.

Mr Koons moves up from the post of vice president and treasurer, which is now filled by E E RETTBERG, JR, formerly assistant treasurer. A L HARSHAW has become secretary replacing I M BUCH, retired.

In the firm's Canadian operation, Scholler Bros Ltd, St Catherines, Ont, Mr Scholler has also assumed the chairmanship, and ROSS C ROGERS has moved up from vice president and treasurer to president. WILLIAM JACKSON, JR fills Mr Rogers' former post, while HAROLD G BARNES replaces Mr Jackson as secretary.

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*P J WOOD, technical director, Royce Chemical Co, Carlton Hill, N J, has been elected a fellow of the Textile Institute.*

*Mr Wood, a native of Leeds, England, is a charter member and past president of AATCC. He is also a fellow of the American Institute of Chemists.*

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Appointment of V W AUBEL, JR to the post of manager of the Philadelphia Sales Branch has been announced by Solvay Process Division, Allied Chemical & Dye Corporation. Mr Aubel succeeds the late C M PETERSON.

In assuming his new duties, Mr Aubel will supervise Solvay sales activities throughout Virginia, Maryland, Delaware, southern New Jersey and eastern Pennsylvania.

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*HARRIS C MILLER, Hooker Electrochemical Co, has been promoted to New York district sales manager. He moves up from the post of assistant New York district sales manager, replacing WILLIAM F GEORGE, who retired last month in line with the company's retirement policy.*

*RAYMOND S BRIGGS, plant engineer with Hooker since 1941, has been named assistant chief engineer. RICHARD W LYKE, assistant plant manager since 1953, succeeds Mr Briggs as plant engineer.*

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Four new sections have been established within the Development and Research Division of The International Nickel Co, Inc, as follows: Constructional Alloy Steels Section, with H V BEASLEY in charge; Electroplating Section, with CLARENCE H SAMPLE in charge; Inco Nickel Alloys Development Section, with T E KIHLGREN in charge; and Stainless Steel and Heat-Resistant Alloys Section, with V N KRIVOBOK in charge.

F L LaQUE, formerly in charge of the Corrosion Engineering Section, now heads the Development and Research Division as vice president and manager; W Z FRIEND succeeds Mr LaQue in the Corrosion Engineering Section. T P MAY and H T PATERSON have been appointed technical manager and operational manager, respectively, of the "Kure Beach" Corrosion Testing Station; and W H SPARR, JR, succeeds Mr Beasley in charge of the Technical Field Section in Pittsburgh.

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*ROGERS B FINCH, former director of the Slater Memorial Textile Research Laboratory at Massachusetts Institute of Technology, has been made special assistant to GEORGE H LEE, director of the Research Division at Rensselaer Polytechnic Institute.*

*CHARLES W BOWDEN, JR, has been named market extension manager of the Industrial Division of Minneapolis-Honeywell Regulator Co, succeeding D M CONSIDINE, who has resigned. Mr Bowden's new duties will include direction of the division's advertising and merchandising programs and its technical and trade publication editorial activities.*

*Mr Bowden has been serving the division as chemical industry sales manager.*

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Election of the following officers of Olin Mathieson Chemical Corporation, formed August 31 by the merger of Olin Industries, Inc, and Mathieson Chemical Corporation, has been announced by JOHN M OLIN, chairman of the board, and THOMAS S NICHOLS, president:

JOHN W HANES, chairman of the finance committee and vice president for finance; F STILLMAN ELFRED, JOHN C LEPPART, STANLEY DE J OSBORNE, executive vice presidents.

RUSSELL R CASTEEL, vice president; NORMAN H COLLISSON, vice president for operations; RUSSELL HOPKINSON, vice president for development; ROBERT W LEA, vice president for organization; R B LEWIS, vice president for financial analysis; DAVID T MARVEL, vice president for sales; MILTON F MEISSNER, vice president for operations; S L NEVINS, vice president for operations; WALTER F O'CONNELL, vice president and assistant to the vice president for finance; FRED OLSEN, vice president for research; RALPH A OSTBERG, vice president for production; J J TOOHY, vice president for operations; THEODORE WEICKER, JR, vice president for overseas operations; EDGAR W TAFT, treasurer; C C TALLMAN, comptroller; GORDON GRAND, JR, secretary; E R VAN VLIET, assistant treasurer; A P WINSOR, assistant secretary.

The officers elected were all formerly associated with one or the other of the predecessor companies.

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*The Virginia Smelting Company, West Norfolk, Virginia, has announced the appointment of JESSE A WEATHERFORD to the position of manager, Industrial Sales Department, and the promotion of D W DUNCAN to the position of plant manager.*

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JOHN WILSON has joined the Synthetics Division of J P Stevens & Co, Inc, where he is directly responsible for the development, merchandising and sales of glass fabrics.

Mr Wilson was previously associated with Owens-Corning Fiberglas Corp.

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*J R JONES, former color representative for Ferro Corp, will head up Claremont Pigment Dispersion Corporation's mid-western headquarters, with offices at 1010 Euclid Bldg, Cleveland 15, O.*

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New appointments to the Research and Development Center of the Chemstrand Corp were announced last month as follows:

*General process activities* — VERNON L BELL; *Chemical engineering group* — GEORGE H BRINKMAN; *Analytical section* — RALPH E DeBRUNNER, DONALD A HOES; *Chemstrand nylon information group at Wilmington* — D H HAGERBAUMER (in charge), J B CHARETON, LLOYD G MOUNT, and ROBERT L TEETER; *Textile testing section* — DAVID E McCONNELL; *Polymer process section* — NICHOLAS R CONGIUNDI; *Polymer section* — LOUIS B GREESON, JR; *Fiber finishing section* — ROBERT J LINCOLN.

Dorman

Stanton

Griffin

*Franklin Process Company of Providence and Philadelphia has augmented its technical staff by the appointment of KENNETH L DORMAN as technical director.*

*Mr Dorman left Goodall-Sanford, Inc, where he was director of laboratories and chief chemist, to assume his new duties.*

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LAURENCE E STANTON has been added to The Goodyear Tire & Rubber Company's Chemical Division field staff to head up the Houston, Tex, sales territory.

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*GEORGE R GRIFFIN has been named to the position of chairman of the Division of Chemistry at Lowell Technological Institute, succeeding ELMER E FICKETT, who recently retired.*

*A native of Indianapolis, Dr Griffin was graduated from the University of Indiana in 1936 and was a teaching fellow in organic chemistry at Boston University, where he received his MA degree in 1938. As an A D Little research fellow at MIT, he obtained his PhD in 1944.*

*Dr Griffin comes to LTI from the Cry-O-Vac division of Dewey and Almy, where he served as supervisor of new plastics research since 1951.*

* * *

*Also new to the LTI family this year is RUSSELL W EHLERS, former chief of the plastics and protective coatings branch of the U S Department of Commerce, who will be chairman of the new department of plastics engineering.*

*Other faculty appointments include G ARTHUR BROWN, instructor, Department of Leather Engineering; THOMAS F McELLIGOTT, Division of Engineering; and HOWARD K MOORE, JOHN P WOOD, and BARBARA A BROWNE, Department of General Studies. Miss Brown will also serve as director of information at the Institute.*

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Atlas Powder Company has announced two changes in the sales staff of the company's chemicals department.

ARTHUR G HEINEL, formerly in charge of the Atlanta office, has been appointed technical representative in charge of a new sub-office in Richmond, Va. He was succeeded in Atlanta by ADRIAN J STEWART, who has been serving as a technical representative in the chemicals department.

Mr Heinel will represent Atlas in Virginia, Washington, D C, the eastern half of West Virginia and North Carolina. Mr Stewart's technical service will be available to Atlas customers for product and applications development in Georgia, central Tennessee, Alabama and Florida.

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*Onyx Oil & Chemical Co, Jersey City, N J, has added JOHN A ROMANO to its staff as an organic chemist in the Organic Research Department. He was formerly with Keuffel & Esser, Chatham, N J.*

*Also named to the Onyx staff are LUCIE TWOMBLY, as supervisor of physical testing, and HARRY HARALAMPOPULOS, as analytical chemist in the Analytical Laboratory.*

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CARL TOEPLER, former superintendent of the Permanent Finishing Dept, Bellman Brook Bleachery, Fairview, N J, has joined Defiance Bleachery, Barrowsville, Mass, as technical director.

*FRANK J SODAY, vice president and director of research and development for The Chemstrand Corp, Decatur, Ala, has been elected president of the Southern Association of Science and Industry, succeeding A P BLACK, head of the Chemistry Department, University of Florida. Dr Soday previously served the Association as vice president at large, 1952-53, and state vice president in Alabama and Arkansas during 1949-51.*

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RALPH K HUBBARD, president of Packard Mills, Webster, Mass, has accepted general chairmanship of the 1954 Fund Campaign of New England Textile Foundation.

Mr Hubbard has announced his staff of Division Chairmen to include the following: Maine Textile Division — LUTHER DANA, Dana Warp Mills; New Hampshire Textile Division — GEORGE K RIPLEY, Troy Blanket Mills; Vermont Textile Division — WILLIAM T DEWEY, A G Dewey Co; Massachusetts Textile Division—THOMAS T CLARK, Talbot Mills; Rhode Island Textile Division — H S NEWCOMBE, Berkshire Fine Spinning Associates; Connecticut Textile Division — MAX DOFT, Princeton Knitting Mills; Wool Merchants Division—JOSEPH MOTTLA, Munro-Kincaid-Mottla; Cotton Merchants Division—EDWARD G LYON, Hazard Cotton Co; Yarn Merchants Division — HUBERT N GRAVES, Franklin Process Company; Dyestuff & Chemical Manufacturers Division — EDWIN H ARNOLD, Arnold Hoffman & Co, Inc; Textile Equipment Manufacturers Division — RICHMOND VIALL, Marshall & Williams Corp.

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*JOHN R GALLOWAY, formerly with International Latex Corp, Dover, Del, will head a newly established Chicago office for Ansul Chemical Company's Industrial Chemicals Sales Division, located at 664 North Dearborn St.*

*The new office will handle midwestern distribution of Ansul's industrial grade sulfur dioxide, methyl chloride and fine organic chemicals.*

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The School of Textiles, North Carolina State College, has announced the following scholarship winners: HARRY H YARBROUGH, JR — American Viscose Corporation Scholarship; EARNEST K SHERRILL — American Enka Corporation Scholarship; JOSEPH PEARSON HESTER — Carbide and Carbon Chemicals Co Scholarship. Yarbrough and Hester are seniors at N C State; Sherrill is a junior.

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*EDMUND M BURAS, JR and LEON SEGAL have been promoted to chemists in charge of cotton research units of the Southern Utilization Research Branch, New Orleans, La. Both men have been with the Southern Laboratory since 1942, except for time in military service.*

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DAVID H BURGER has joined the M A Division, Wyandotte Chemicals Corporation, as administrative assistant in the organics group.

Immediately prior to joining Wyandotte, Mr Burger was a sales representative in Los Angeles for the Celanese Corporation of America.

Buras

Segal

Burger

Darsey

ROBERT K JOHNSON has been promoted to the position of director of analytical laboratories at the Hilton-Davis Chemical Company, a Division of Sterling Drug Inc. Mr Johnson was previously senior analytical chemist for the concern.

As previously noted JOHN A DARSEY has been appointed by Hilton-Davis as technical sales representative to textile mills in North Carolina and Virginia, operating from the Greenville, S C, regional headquarters, which is managed by S Y STRIBLING III. Mr Darsey was formerly with Du Pont in Atlanta as a technical demonstrator.

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Bukaty

*RAYMOND M BUKATY has been named director of marketing on the staff of executive vice president JOHN H HILLDRING of General Aniline & Film Corporation.*

*Before joining General Aniline Mr Bukaty was with the management consulting firm of Booz, Allen & Hamilton and previously was a marketing executive with the General Electric Company.*

*In his new position Mr Bukaty will work in cooperation with S H WILLIAMS, vice president and general sales manager of the Dyestuff and Chemical Division; WILLIAM BALCH, general sales manager of the Ansco Division; and L P Naylor, general sales manager of the Ozalid Division.*

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Salley

Two new departments, the Basic Research Department, and the Research Service Department, have been created within American Cyanamid Company's Research Division. Both departments are at the Stamford Research Laboratories. The Research Service Department is a consolidation of numerous service functions at Stamford, including the library, analytical and testing, instrumentation, etc. It will, in addition to rendering services to other departments, carry on research in methods and instrumentation.

D J SALLEY has been named assistant director of the Basic Research Dept (J T THURSTON, director of the Stamford Research Laboratories, will be acting director of the Department) and R H KIENLE has been named director of the Research Service Dept. R P CHAPMAN will be assistant director of the Department.

Kienle

Also within Cyanamid's Research Division, J M SALSBURY has been named manager of the Bound Brook, N J, Laboratories; CHARLES MARESH, manager of the Bound Brook Research Service Section; and CHARLES R WITSCHONKE has been transferred to the Stamford Laboratories as assistant to Mr Kienle.

JAMES W GILMAN has been appointed sales representative in the Pacific Northwest for Cyanamid's Plastic and Resins Division. E B CORDON, in charge of the West Coast technical service for Cyanamid's coating resin accounts, will continue to serve the San Francisco area as well as southern California. He will also make occasional trips to the Northwest.

Chapman

New assignments within the Bound Brook plant's Technical Dept (Organic Chemicals Div) are as follows: STANLEY M DAVIS will supervise the new identification and physical measurements laboratory of the analytical section; FRANKLIN C DEXTER has been appointed special assistant to L F VAN ECK, manager of the analytical section; and ISAIAH VON has been named a group leader in dyes development.

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Madden

*JOSEPH P MADDEN has joined Antara Chemicals, a sales division of General Aniline & Film Corporation, as manager of inorganic chemicals.*

*Mr Madden was formerly assistant sales manager of Stauffer Chemical Company, New York, in charge of alkalies, chlorine and chlorinated products. More recently, he was vice-president of Caldwell Chemical Company.*

# OBITUARY

### Robert Haller

PROFESSOR DR ROBERT HALLER, acknowledged as one of the greatest textile chemists and colorists of our time, died recently in his 81st year. He had just celebrated his 80th birthday amid the acclaim and praise of chemists the world over.

Prof Haller represented the ideal embodiment of his profession. Of his generation, he was the outstanding exponent of the application of chemical and technical principle to the art of coloring textiles. One of the founders of the Swiss Association of Chemist-Colorists, he was the society's first president. He was also elected president of the International Association of Chemist-Colorists, and later, after the passing of Dr Giovanni Tagliani, he became president of the International Federation of Associations of Textile Chemists and Colorists.

During his life, Prof Haller worked increasingly to improve the means of exchange of information among his colleagues, and among the coloristic associations of the world.

His research in cellulose chemistry is well known, and together with his studies in dye application, his published material numbered over 250 books, articles and reports. In a privately printed book, "The Colorist," he reviewed his long and fruitful life, always stressing the importance of mutual help and cooperation, and delineating so piquantly the private affairs so characteristic of a continental chemist-colorist.

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### W Roy Geddes

W ROY GEDDES, vice president of North American Cyanamid Ltd, died last month in the Humber Memorial Hospital, Weston, Ontario, at the age of 57.

Widely known in the Canadian chemical industry, Mr Geddes had been associated with North American Cyanamid since 1948.

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### John M O'Malley

JOHN MARTIN O'MALLEY, former textile chemist with Collingbourne Mills, Elgin, Ill, died recently in a hospital at North Bergen, N J, after a lingering illness.

Mr O'Malley is survived by his widow, a son and daughter, and a brother.

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### Glen S Hiers

GLENN S HIERS, 58, a research executive of Collins & Aikman Corp, died suddenly last month aboard an Akron-bound train.

Dr Hiers, who held membership in AATCC and ACS, had been with the Philadelphia firm since 1928. He is survived by his widow and two sons.